

Pinkboy1006

TONO

θ-5000E
SERVICE MANUAL

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SUPPLEMENT
- SERVICE MANUAL OF BUILT-IN MONITOR -

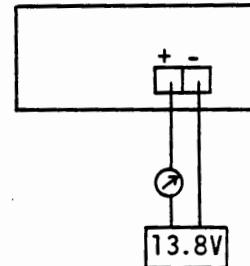
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1. POWER SUPPLY CIRCUIT

Fuse: for DC installed at a fuse clip on the power supply board (midget type).
for AC 100-120V inserted in a fuse holder on the rear panel.
for AC 200-240V inserted in a fuse holder on the rear panel.

1.1 DC

Pull out the AC cord.
Connect the DC power supply (13.8V-14V) to the Theta-5000E through an ampare meter (2A-3A).
Turn on the DC power supply and then the power switch of the Theta-5000E.
The value of current should be approx. 1.4A.
Check if there is no abnormal oscillation at +5VDC and +12VDC outputs.



[PROBLEMS]

1. Over-current (including fuse cut)

- 1) Is there any short circuit at D30 (DBA30), D32 (RD30E or the equivalent 30V zener diode)?
- 2) Does the over-current run even when CN8 is removed?

YES

Check the parts on the power supply board.

NO

Remove the other connectors CN2, CN5, CN9, CN6 and CN3 to check if there is any defect on the CPU board or the other boards.

2. No current runs

- 1) Check the fuse.
- 2) S1 switch may be defective.
- 3) AC socket may be defective.
- 4) CN8 may be defective of contact.
- 5) IC53 (7805) and IC54 (7812) may be defective.
- 6) D30 (DBA30) may be defective.

3. Abnormal oscillation

- 1) Do both of IC53 and IC54 oscillate abnormally?

YES

The capacity of C150 (47μ) may be deficient.

2) IC53 oscillates abnormally. → The capacity of C119 (0.33μ) may be deficient or IC53 may be defective.

3) IC54 oscillates abnormally. → The capacity of C118 (0.33μ) may be deficient or IC54 may be defective.

4. Increase/decrease of current

1) When the +5VDC output is greatly changed, → Check if R157 (39 ohms) the thermal protector of IC53 is working. is broken down.

2) When the +12VDC output is greatly changed, → Check if R155 (33 ohms) the thermal protector of IC54 is working. is broken down.

3) Both the +5VDC and +12VDC outputs are greatly changed. → Check the AC power supply voltage. It should not exceed 125V or 250V.

NOTE: Even though a great voltage is measured at the +5VDC and +12VDC outputs when the power supply board is in no-load state with CN8 removed, the unit is considered to be in normal state in case the rated voltage is obtained with the rated load.

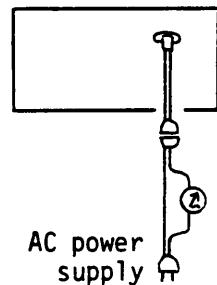
1.2 AC

Attach the AC cord to the unit.

Connect the unit to the AC power supply through an ampare meter (1A).

Turn on the power switch of the Theta-5000E.
See if the input/output voltage of IC53 (7805) and IC54 (7812) are as shown below.

Also see if there is no abnormal oscillation at the +5VDC and +12VDC outputs.

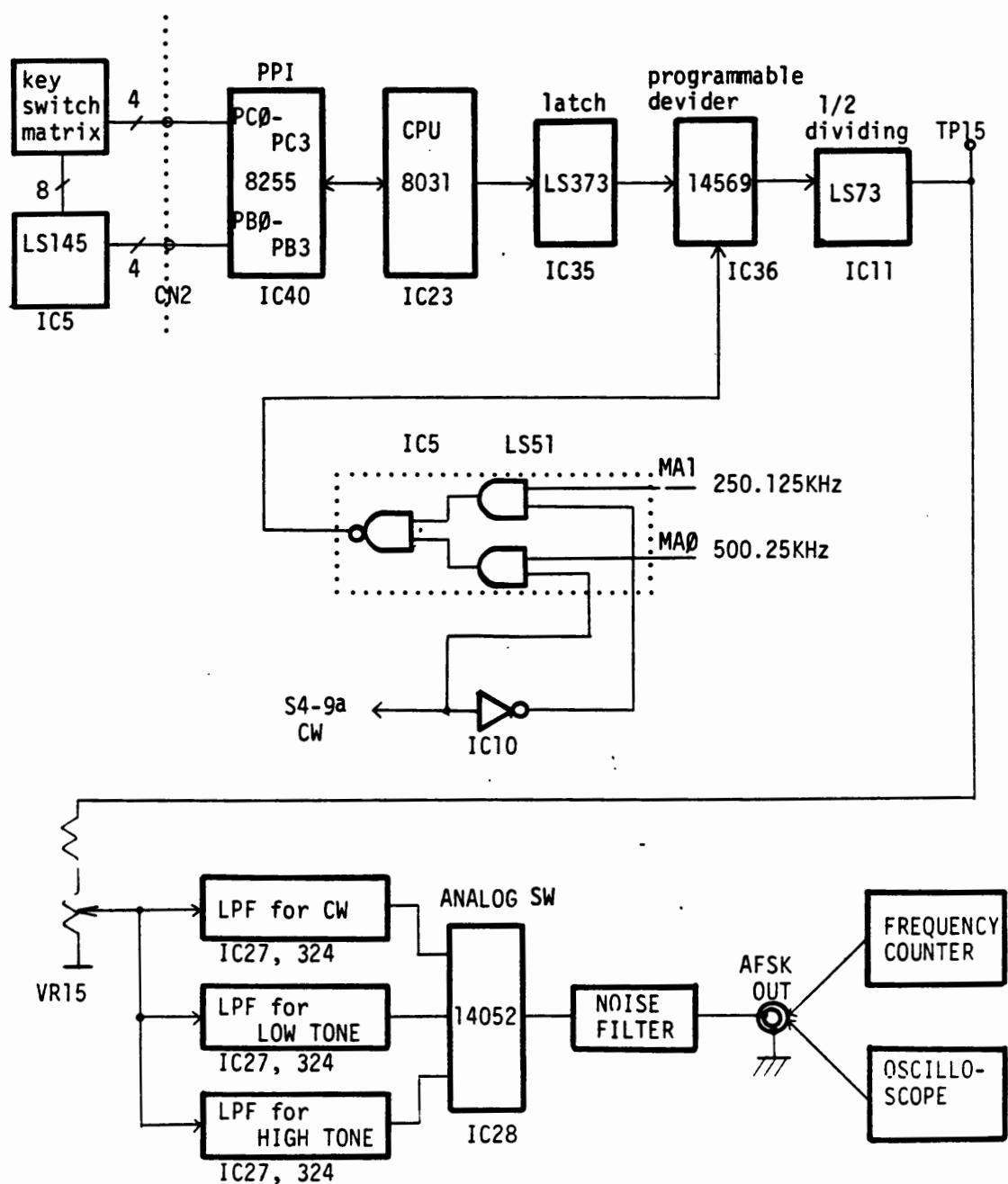


| AC Voltage | AC Current | IC53, IC54 Input Voltage | IC53 Output | IC54 Output |
|------------|---------------|-------------------------------------|-------------|---------------|
| 115V | approx. 0.5A | approx. 22V (ripple under 2Vp-p) | 4.8V - 5.2V | 11.5V - 12.5V |
| 220V | approx. 0.25A | approx. 21V (ripple under 2Vp-p) | 4.8V - 5.2V | 11.5V - 12.5V |

[PROBLEMS]

Refer to the [PROBLEMS] in the "1.1 DC" section.

AFSK OUTPUT DIAGRAM



2. AFSK OUTPUT

Connect a frequency counter and an oscilloscope, or voltage meter (100mV) to the AFSK output terminal of the unit.

Set AFSK GAIN to maximum.

The output frequency should stay within +/- 1Hz of the frequencies as shown in the table below. The output level should be approx. 80mVpp.

| MODE | TONE | SHIFT | SENSE | OUTPUT FREQUENCY |
|---------|------|-------|-------|------------------|
| MORSE.E | -- | --- | OUT-R | 828.2 Hz |
| TOR.B | -- | --- | OUT-N | 1613.7 Hz |
| | | | OUT-R | 1786.6 Hz |
| BAUDOT | L.T. | --- | OUT-N | 1276.1 Hz |
| | | 170 | OUT-R | 1445.8 Hz |
| | | 425 | OUT-R | 1701.5 Hz |
| | | 850 | OUT-R | 2119.7 Hz |
| | H.T. | --- | OUT-N | 2119.7 Hz |
| | | 170 | OUT-R | 2294.7 Hz |
| | | 425 | OUT-R | 2552.3 Hz |
| | | 850 | OUT-R | 2979.2 Hz |

---: don't care

[PROBLEMS]

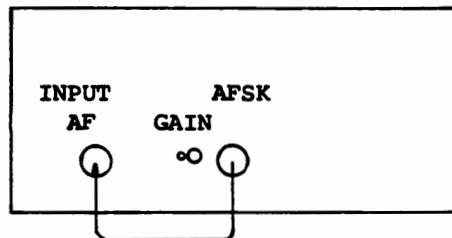
1. Accurate frequency is not obtained.

- 1) System clock may not be set to 8.004MHz. → Check TP13.
- 2) Either of IC35 (LS373), IC36 (14569) or IC5 (LS51) may be defective.
- 3) The frequencies shown in above table are obtained, but the combination of MODE, TONE, SHIFT and SENSE is not corresponding to the table.
 ↓
 Check PB0-PB3 and PC0-PC3 of IC40 (8255) to the keyboard switches on the front panel, and IC5 (LS145), D52, D53, D54, R213, R214 and the arounds.

2. No output

- 1) Check IC5 (LS51), IC36 (14569), IC11 (LS73), IC27 (324), IC28 (14052) and the arounds.
- 2) Check if there is any damage on VR15 (AFSK GAIN VOL).

3. DEMODULATOR



If no faults were found in AFSK output, connect AFSK output to the INPUT AF jack and get maximum gain.

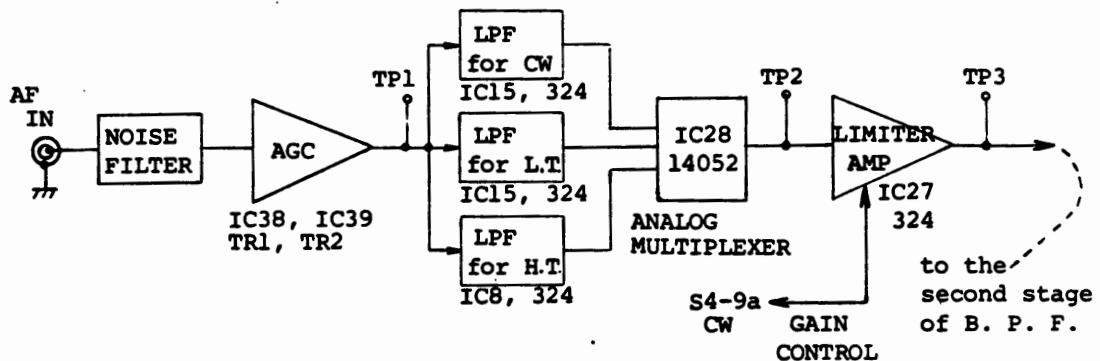
Table 3-1

| MODE | TONE | SHIFT | SENSE | AFSK OUT Freq. | TP1 | TP3 | Test Point | VR to be adjusted |
|---------|------|-------|-------|----------------|----------------|----------------|----------------|-------------------|
| MORSE.E | — | — | OUT-R | 828.2 Hz | 0.8-1.0Vpp | 2.2-2.5 Vpp | TP5 2.1-2.4Vpp | VR9 |
| TOR.B | — | — | OUT-N | 1613.7 Hz | | | TP5 1.6-1.8Vpp | VR11 |
| | | | OUT-R | 1786.6 Hz | | | TP4 1.6-1.8Vpp | VR4 |
| BAUDOT | L.T. | — | OUT-N | 1276.1 Hz | 1.3-1.4 Vpp | TP4 1.6-1.8Vpp | TP5 1.6-1.8Vpp | VR10 |
| | | 170 | OUT-R | 1445.8 Hz | | | TP4 1.6-1.8Vpp | VR1 |
| | | 425 | OUT-R | 1701.5 Hz | | | TP4 1.6-1.8Vpp | VR2 |
| | | 850 | OUT-R | 2119.7 Hz | | | TP4 1.6-1.8Vpp | VR3 |
| | H.T. | — | OUT-N | 2119.7 Hz | TP4 1.6-1.8Vpp | TP5 1.6-1.8Vpp | TP4 1.6-1.8Vpp | VR12 |
| | | 170 | OUT-R | 2294.7 Hz | | | TP4 1.6-1.8Vpp | VR5 |
| | | 425 | OUT-R | 2552.3 Hz | | | TP4 1.6-1.8Vpp | VR6 |
| | | 850 | OUT-R | 2979.2 Hz | | | TP4 1.6-1.8Vpp | VR7 |

Setting of other switches: AF-IN, IN-N, SPEED=L.S., AFSK GAIN=MAX.,
FINE tuning vol.=center

NOTE) — : DON'T CARE

3.1 AGC Circuit · The First Stage of Band Pass Filter



Change MODE, TONE, SHIFT and SENSE as shown in Table 3-1.
Amplitude of TP1 and TP3 should be as shown in Table 3-1.

[PROBLEMS]

1. No signal or too little signal is output from TP1.
→ Check IC38 (3301), IC39 (3301), TR1 (2SC536) and TR2 (2SC536), and check if the circuit is disconnected or short-circuit between the AF IN jack and TP1.
2. Excessive signal is output from TP1.
→ Check the feed back circuit between R6 and C8.
3. No signal or too little signal is output from TP3 regardless of MODE, TONE, SHIFT and SENSE.
→ Check IC28 (14052) if no signal is output into TP2.
Check IC27 (324) if any signal is output into TP2.
4. No signal or too little signal is output from TP3 in a certain state of MODE, TONE, SHIFT and SENSE.
→ Check IC15 (324), IC8 (324) and IC28 (14052).

3.2 Adjustment of the second stage of Band Pass Filter

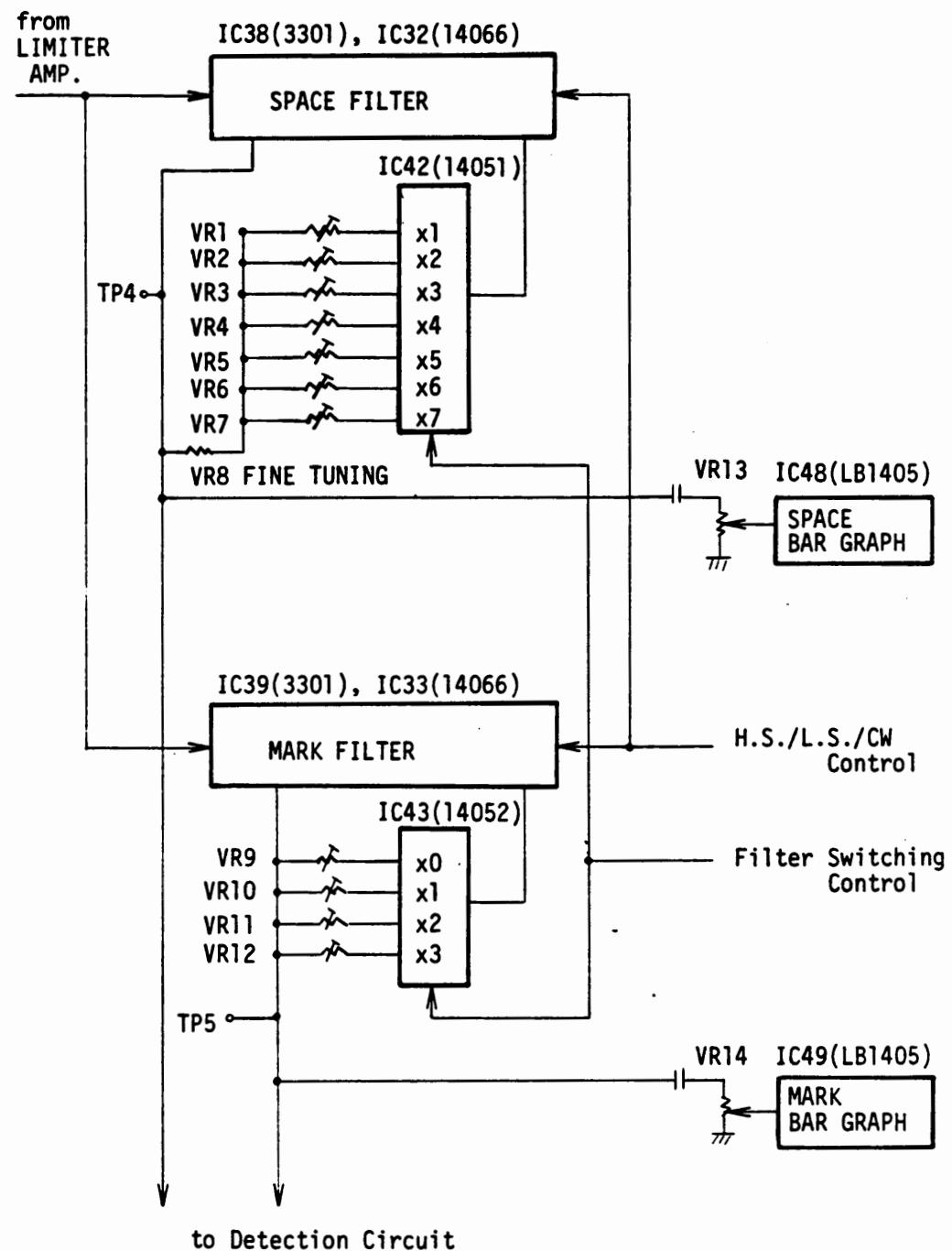


Table 3-2 Truth Value Table of Filter Switching Circuit

| MODE | TONE | SHIFT | A(IC21, pin3) | B(IC21, pin11) | C(IC6, pin11) | a(IC13, pin11) | b(IC6, pin11) |
|---------------------------|------|-------|------------------|-------------------|------------------|-------------------|------------------|
| MORSE.E MORSE.J | — | — | 0 | 0 | 0 | 0 | 0 |
| BAUDOT/TOR.C ASCII/JIS | L.T. | 170 | 1 | 0 | 0 | 1 | 0 |
| " | L.T. | 425 | 0 | 1 | 0 | 1 | 0 |
| " | L.T. | 850 | 1 | 1 | 0 | 1 | 0 |
| TOR.A TOR.B | — | — | 0 | 0 | 1 | 0 | 1 |
| BAUDOT/TOR.C ASCII/JIS | L.T. | 170 | 1 | 0 | 1 | 1 | 1 |
| " | L.T. | 425 | 0 | 1 | 1 | 1 | 1 |
| " | L.T. | 850 | 1 | 1 | 1 | 1 | 1 |

NOTE: 0: Low Level 1: High Level

Change MODE, TONE, SHIFT and SENSE as shown in Table 3-1 and adjust corresponding trimmer potentiometer to get maximum output from TP4 and TP5. Maximum amplitude should be 1.6Vpp through 1.8Vpp.

[PROBLEMS]

1. No normal signal is output in spite normal signal is sent to SPACE filter, or the situation is incapable of adjustment:
 - 1) Check IC38 (3301), IC42 (14051), IC32 (14066), VR8 (FINE), the trimmer potentiometer corresponding to MODE, TONE and SHIFT which outputs no signal, and poor connection of CN2.
 - 2) Check if the output of "A", "B" and "C" in the filter switching circuit is corresponding to the Truth Value Table.
- NO Check IC21 (LS08), IC6 (LS00), IC19 (LS04), IC13 (LS32), MODE switch, TONE switch, SHIFT switch and CN2.

2. No normal signal is output in spite normal signal is sent to MARK filter, or the situation is incapable of adjustment.
- 1) Check IC39 (3301), IC43 (14052), IC33 (14066) and the trimmer potentiometer corresponding to MODE and TONE which output no signal.
- 2) Check if the output of "a" and "b" in the filter switching circuit is corresponding to the Truth Value Table.
- NO Check IC21 (LS08), IC6 (LS00), IC19 (LS04), IC13 (LS32), MODE switch, TONE switch, SHIFT switch and CN2.

3.3 Adjustment of BAR GRAPH

SPACE indicating BAR GRAPH

Set the unit in the following state: MODE=BAUDOT, TONE=L.T., SHIFT SHIFT=170, OUT-R, SPEED=L.S., AF-IN, IN-N, AFSK GAIN=MAX., FINE TUNING VOLUME=center.

Turn VR13 to minimum, then turn it clockwise gradually till the fifth LED lights.

MARK indicating BAR GRAPH

Set the unit in the following state: MODE=BAUDOT, TONE=L.T., OUT-N, SPEED=L.S., AF-IN, IN-N, AFSK GAIN=MAX.

Turn VR14 to minimum, then turn it clockwise gradually till the fifth LED lights.

[PROBLEM]

1. LED does not light to maximum for all proper signal is output to TP4 and TP5.

Check VR13, VR14, IC48 (LB1405), IC49 (LB1405) and CN2.

3.4 Detection Circuit

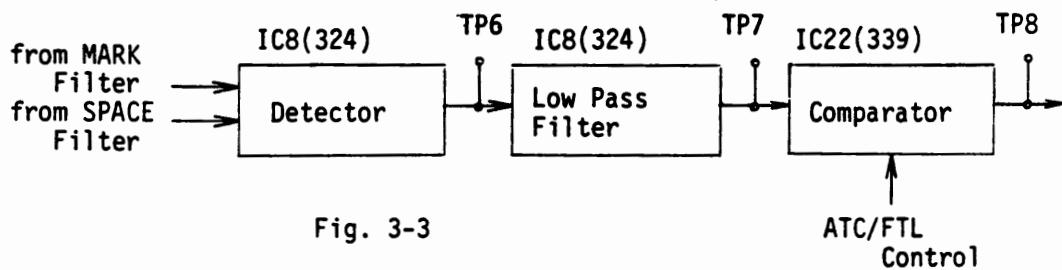


Fig. 3-3

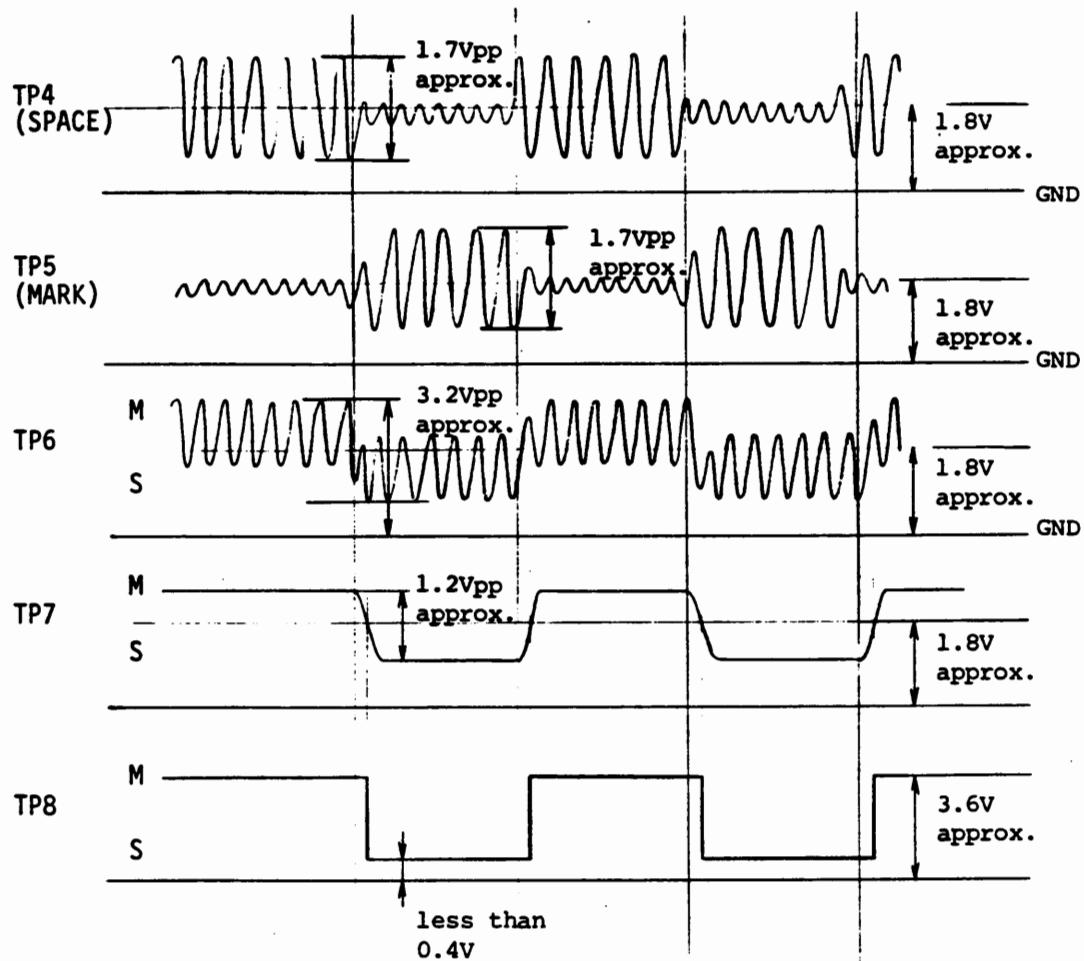


Fig. 3-4.

Set the unit in the following state: MODE=BAUDOT, TONE=L.T., SHIFT=170, SPEED=L.S., THRESHOLD=ATC.

Transmit "RY" test message repeatedly at 50 BPS by pressing "REPT" "Y".

Make sure that amplitude of TP6 through TP8 is as shown in Fig. 3-4.

Make sure that the waveform of TP6 through TP8 does not change even when the THRESHOLD control is changed to FTL.

Make sure that the waveform remains in normal when the state is changed to: SPEED=H.S., THRESHOLD=ATC, Baud Rate=200 BPS.

[PROBLEMS]

1. The waveform of TP6 is not normal. → Check D17 through D22 and IC8 (324).
2. The waveform of TP7 is not normal. → Check IC7 (14066) and IC8 (324).
3. The waveform of TP8 is not normal. → Check D23, D24, D25, IC7 (14066) and IC22 (324).

4. The waveform does not remain in normal when the speed setting is changed to 200 BPS. → Check IC7 (14066), IC14 (LS02), CN2, S5-6a, IC32 (14066) and IC33 (14066).

NOTE: It is recommended to compare the waveform with normal one by using two-channel oscilloscope, for it is very difficult to judge singly whether the waveform is normal or not.

3.5 ANTI-NOISE Switching, AF-TTL Switching, Input Polarity Switching Circuit

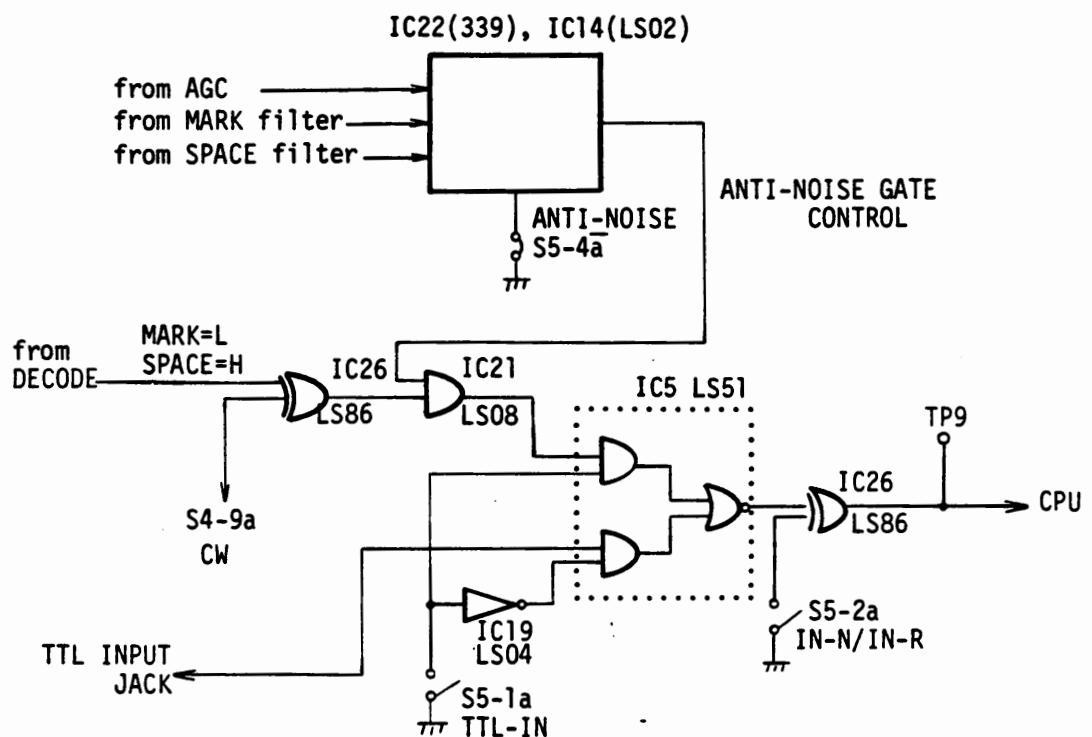


Fig. 3-5

Level of TP9

| Polarity Code | IN-N | IN-R |
|---------------|--------------------|--------|
| CW | MARK =L SPACE=H | H L |
| Other Codes | MARK =H SPACE=L | L H |

The ANTI-NOISE circuit works in the state of A.N.=ON to open the GATE when the input signal from MARK FILTER or SPACE FILTER is larger than the one from AGC. Set the unit as follows: MODE=BAUDOT, SPEED =L.S., TONE=L.T., SHIFT=850, A.N.=ON, AF-IN. Make connection between INPUT AF and the variable audio generator.

Increase the frequency of the audio generator from around 800 Hz to make sure that the 1 pin level of IC22 (339) decreases from approx. 5V to OV when the output level of TP5 becomes 1.1 - 1.2V.

Increase the frequency furthermore to make sure that the output level of TP5 becomes 1.0 - 1.1V when the frequency becomes higher than 1275 Hz and that the 1 pin level of IC22 increases from OV to approx. 5V.

Make sure that if the state is changed to A.N.=OFF when the 1 pin level of IC22 is approx. 5V, the level decreases to OV.

The TP9 level corresponding to MARK and SPACE is as shown in Fig. 3-5.

[PROBLEMS]

1. ANTI NOISE circuit does not open.

Check IC22 (339), IC14 (LS02) and IC21 (LS08).

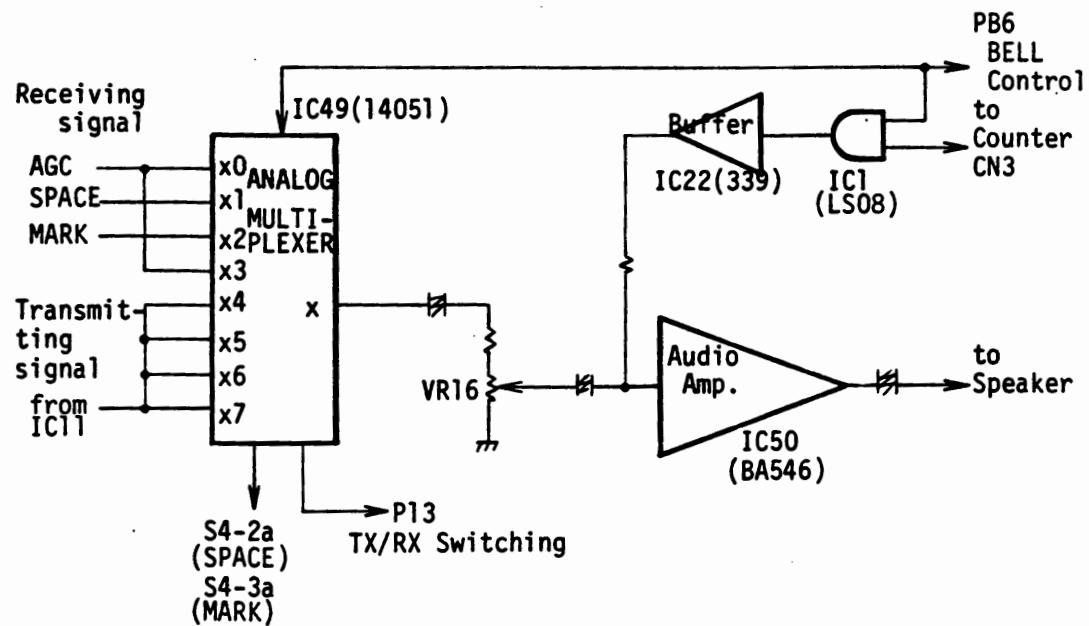
2. ANTI NOISE circuit is left opened.

Check IC22 (339), IC14 (LS02) and S5-4a.

3. The polarity of the input signal does not reverse.

Check IC26 (LS86), S5-2a and CN2.

4. AUDIO MONITOR CIRCUIT



The input signal sound being monitored is switched by S4-2a and S4-3a.
 The input/output signal sound is switched by P13.
 It is controlled by PB6 to inject the bell sound into the audio monitor circuit.

[PROBLEMS]

1. No sound or too small sound is heard.
 → Check IC50 (BA546), VR16, the speaker, J8, CN9 and S1d.
2. Only a certain sound is heard.
 → Check IC49 (14051), CN2, S4-2a and S4-3a.
3. No bell sound is heard.
 → Check IC22 (339) and IC1 (LS08).

5. RESET, BATTERY-BACK-UP CIRCUIT

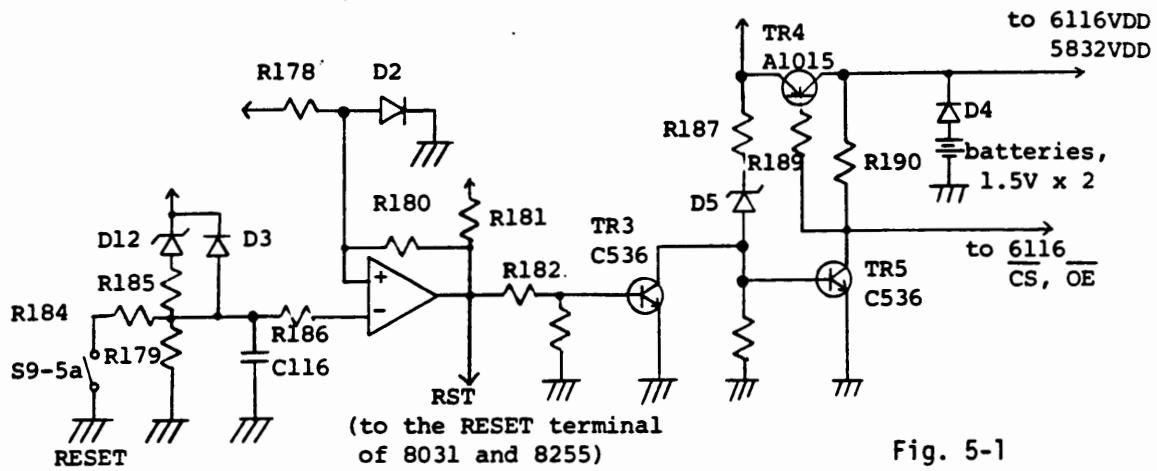


Fig. 5-1

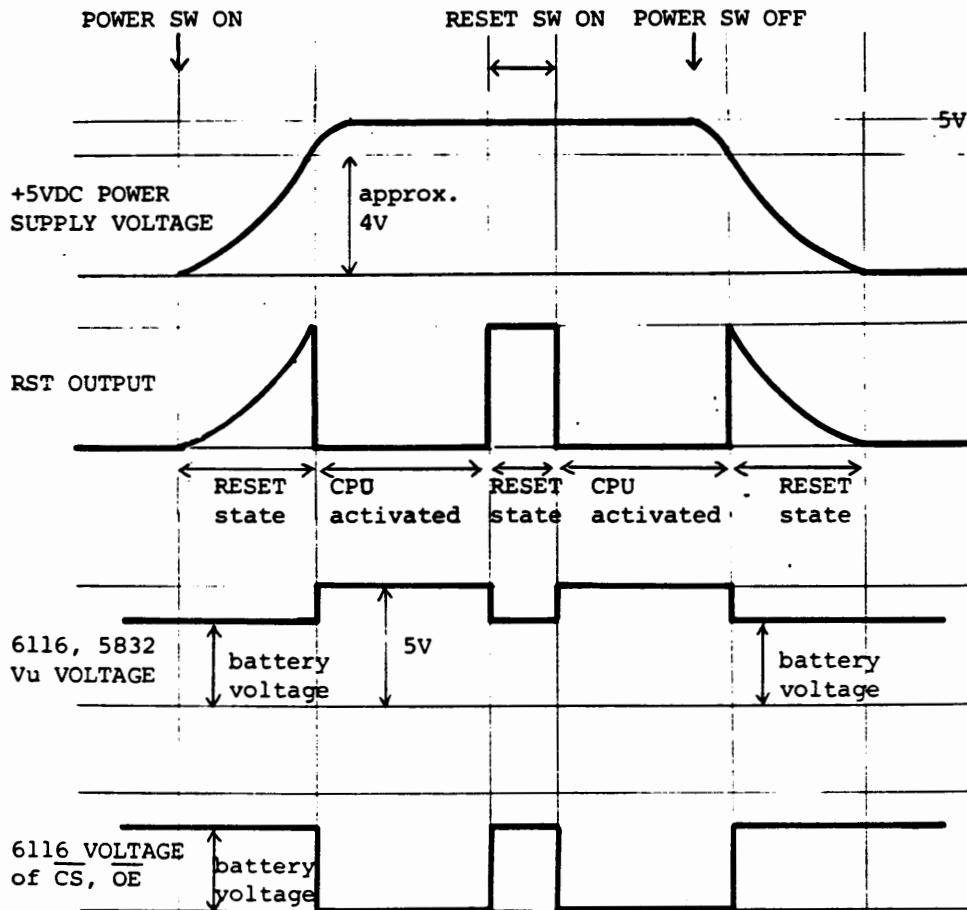


Fig. 5-2

As shown in Fig. 5-2, when the RESET switch is pressed or when POWER ON/OFF, the reset circuit generates a reset pulse and the battery-back-up circuit switches the Vdd of IC31 (6116) and IC46 (5832) between the +5VDC main power supply and batteries, and at the same time generates high level voltage against CS and OE of IC31 (6116) in order not to be chip-selected.

[PROBLEMS]

- When power is turned on, no reset function is activated and CPU runs away.



The capacity of C116 may be deficient, IC22 (339) may be defective, check D2, D3 and D12.

- When power is turned on, the reset function is activated properly, but no reset function is activated when the RESET button is pressed.



Check from S9-5a (RESET button) to R184 through CN2.

- Memorized date is cleared.

Check the battery voltage, check TR3, TR4, TR5, D4 and D5.

6. FULL KEYBOARD

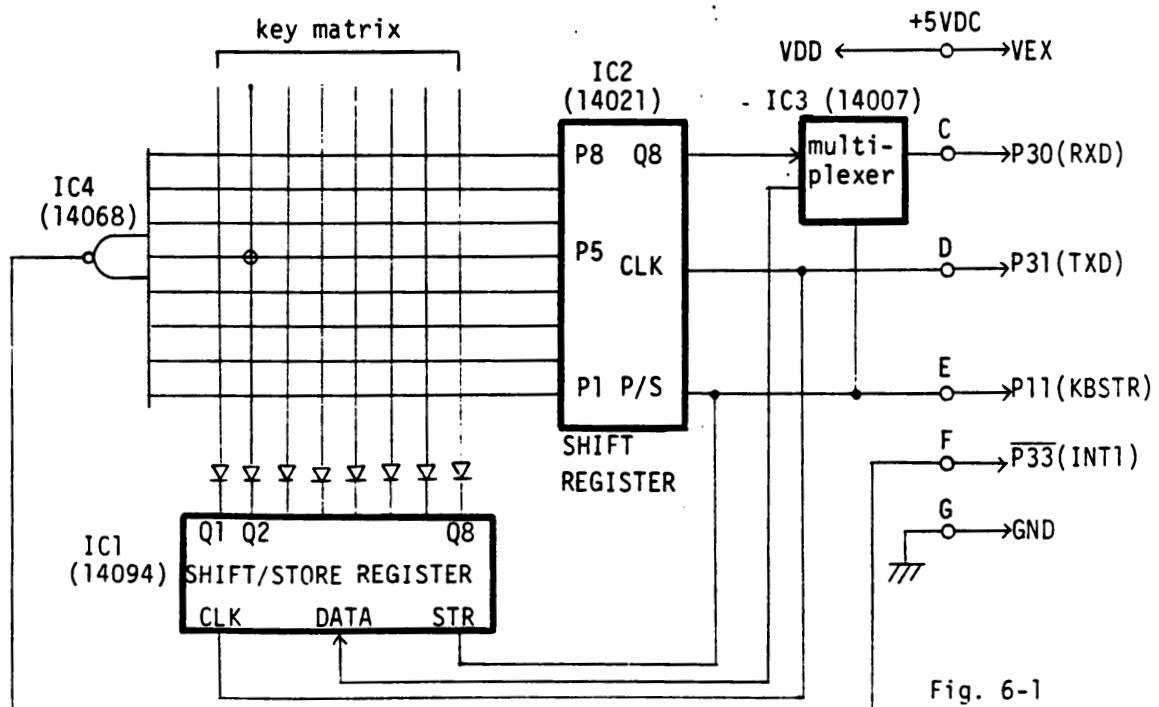


Fig. 6-1



key matrix

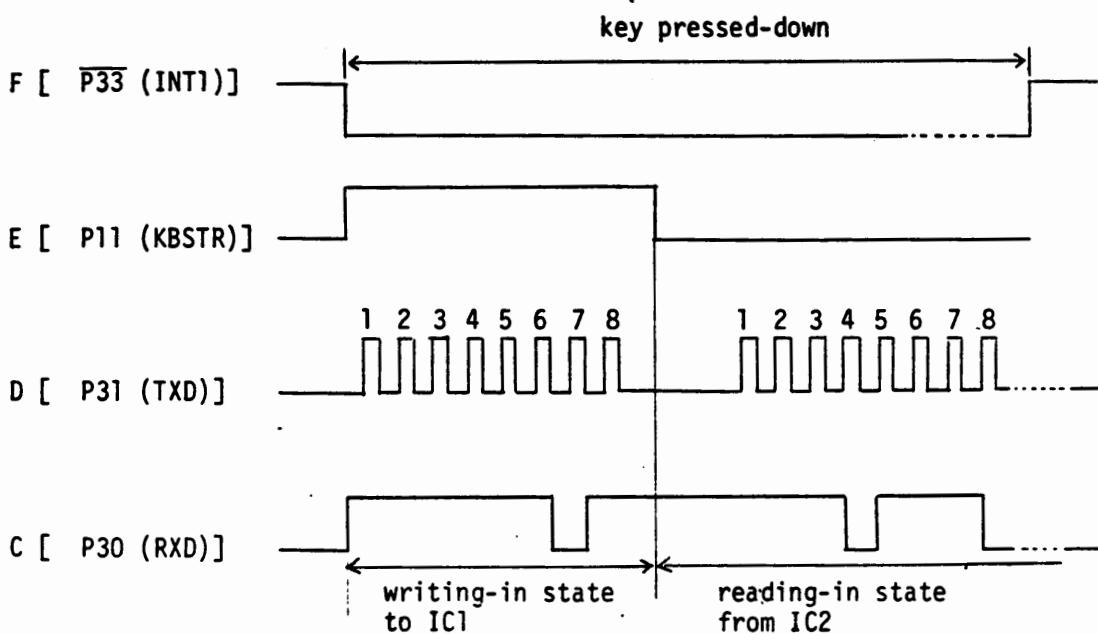


Fig. 6-2 Full Keyboard Timing
(The detecting timing when the °marked key in Fig. 6-1 is pressed down.)

When the keys are not pressed down, every output from IC1 is set to L level and the full keyboard is stopping its keyboard scan. Any keystroke is detected by IC4 (14068) and starts the keyboard scan.

- P11 (KBSTR) is set to H level to enable programming in IC1 (14094).
- The data which is to be programmed in Q8 is set to P30.
- One clock pulse is generated from P31 and IC2 is shifted.
- The same procedure is repeated eight times as shown in the figure to set date to Q1-Q8.
- P11 is set to L level to enable reading-out from IC2 (14021).
- The data sent to Q8 with CPU.
- One clock pulse is generated from P31 and IC2 is shifted.
- The next data is output to Q8.
- The same procedure is repeated eight times to read every data from P1-P8 with CPU.

[PROBLEMS]

1. No keying accepted

- 1) The keyboard cable may be disconnected or check if CN6 is defective or contact.
- 2) Check IC1 (14094), IC2 (14021), IC3 (14007) and IC4 (14068) on the keyboard PCB.
- 3) Check P30, P31, P33 and P11 of the CPU (8031), and also IC19 (LS04).

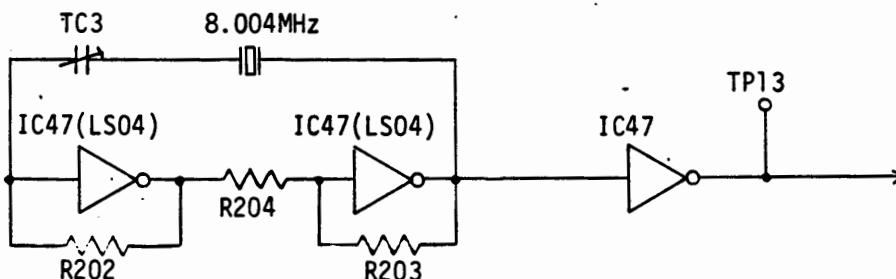
2. The keying of a specified group of keys is not accepted.

↓
Check IC1 (14094), IC2 (14021), D1-D8, IC4 (14068) and R9.

3. The keying of a specified key is not accepted.

↓
The key-switch may be defective.

7. SYSTEM CLOCK OSCILLATION CIRCUIT



After warming up the unit, the output frequency of TP13 should stay within 8004.000KHz +/- 0.050KHz. If not, adjust TC3 to make it stay within the range.

[PROBLEMS]

1. Frequency error → Re-adjust with TC3.
2. No oscillation → Check IC47 (LS04), crystal oscillator and trimmer capacitor TC3.

8. CPU AND THE AROUND

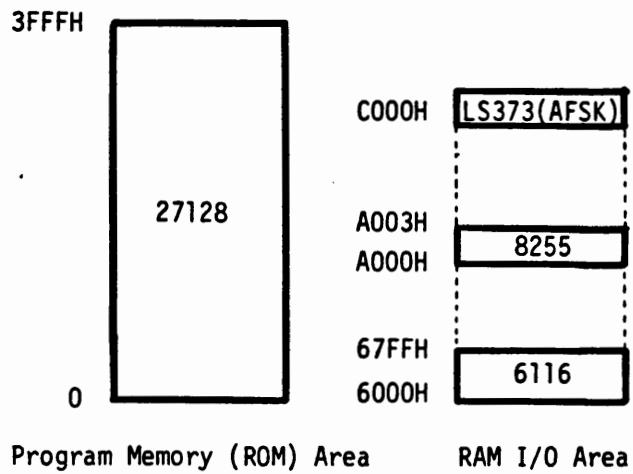


Fig. 8-1 Memory Map

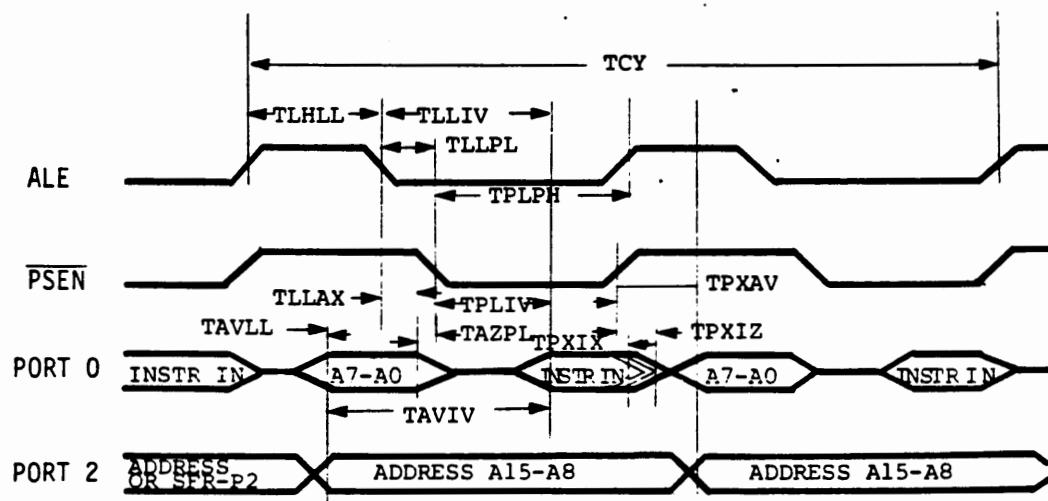


Fig. 8-2 Program Memory Read Cycle Wave Forms

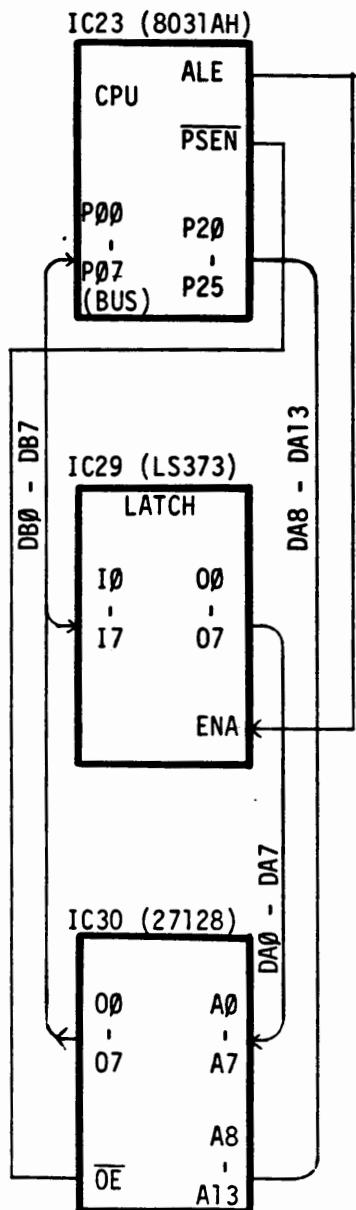
PROGRAM MEMORY CHARACTERISTICS

| Symbol | Parameter | 12 MHz Clock | | | Variable Clock 1/TCLCL = 1.2 MHz to 12 MHz | | |
|--------------------|-------------------------------------|--------------|-----|-------|---|------------|-------|
| | | Min | Max | Units | Min | Max | Units |
| TLHLL | ALE pulse Width | 127 | | ns | 2TCLCL-40 | | ns |
| TAVLL | Address Setup to ALE | 53 | | ns | TCLCL-30 | | ns |
| TLLAX1 | Address Hold After ALE | 48 | | ns | TCLCL-35 | | ns |
| TLLIV | ALE To Valid Instr In | | 233 | ns | | 4TCLCL-100 | |
| TLLPL | ALE To <u>PSEN</u> | 58 | | ns | TCLCL-25 | | ns |
| TPLPH | <u>PSEN</u> Pulse Width | 215 | | ns | 3TCLCL-35 | | ns |
| TPLIV | <u>PSEN</u> To Valid Instr In | | 125 | ns | | 3TCLCL-125 | ns |
| TPXIX | Input Instr Hold After <u>PSEN</u> | 0 | | ns | 0 | | ns |
| TPXIZ ¹ | Input Instr Float After <u>PSEN</u> | | 63 | ns | | TCLCL-20 | ns |
| TPXAV ¹ | Address Valid After <u>PSEN</u> | 75 | | ns | TCLCL-8 | | ns |
| TAVIV | Address To Valid Instr In | | 302 | ns | | 5TCLCL-115 | ns |
| TAZPL | Address Float To <u>PSEN</u> | 0 | | ns | 0 | | ns |

NOTE:

1. Interfacing the 8051AH to devices with float times up to 75ns is permissible.
This limited bus contention will not cause any damage to Port 0 drivers.
2. TCLCL=Oscillator Period.

8-1 Program Memory



Port 0 of CPU 8031AH is an 8-bit open drain bidirectional I/O port, and also is a multiplexed low-order address and a data bus as shown in the waveform of Fig. 8-4.

Port 2 is an 8-bit quasi-bidirectional I/O port which emits a high-order address.

ALE provides the Address Latch Enable output which is to be used to latch a low-order address to external memory.

PSEN (Program Store Enable Output) is a control signal which enables external memory to bus during the external fetch operations.

IC29 (LS373) is used as a low-order latch, which provides the low-order address to IC30 (27128), IC40 (8255) and IC31 (6116) through multiplexer during normal operation.

[PROBLEMS]

1. CPU doesn't work at all.
 - 1) Check the system clock circuit.
 - 2) Check IC29 (LS373) and IC23 (8031AH).
2. CPU runs away.
 - 1) Check the system clock circuit and the reset circuit.
 - 2) Check IC23 (8031AH), IC29 (LS373) and IC30 (27128).

8-2 RAM

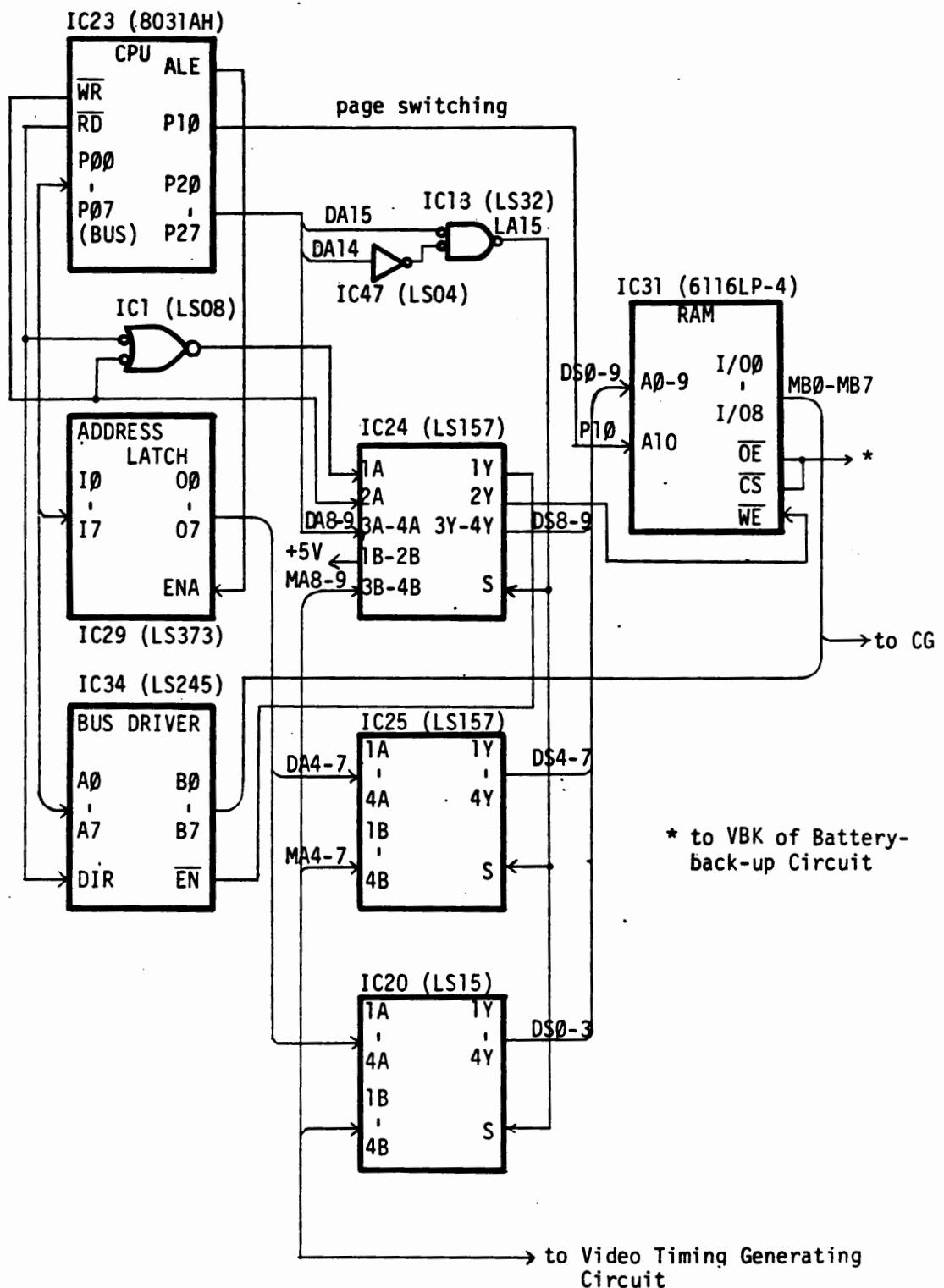


Fig. 8-3

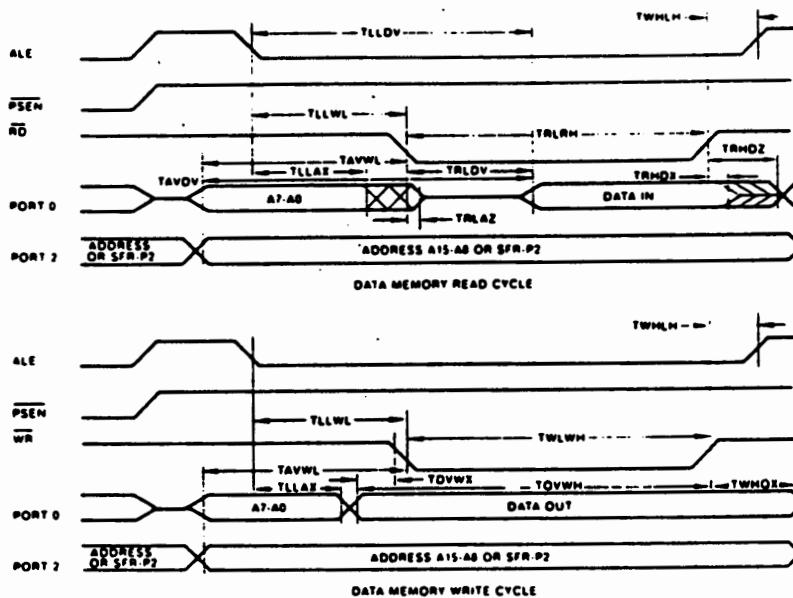


Fig. 8-4

EXTERNAL DATA MEMORY CHARACTERISTICS

| Symbol | Parameter | 12 MHz Clock | | | Variable Clock 1/TCLCL = 1.2 MHz to 12 MHz | | |
|--------|-----------------------------|--------------|-----|-------|---|------------|-------|
| | | Min | Max | Units | Min | Max | Units |
| TRLRH | RD Pulse Width | 400 | | ns | 6TCLCL-100 | | ns |
| TWLWH | WR Pulse Width | 400 | | ns | 6TCLCL-100 | | ns |
| TLLAX2 | Address Hold After ALE | 132 | | ns | 2TCLCL-35 | | |
| TRLDV | RD To Valid Data In | | 250 | ns | | 5TCLCL-165 | ns |
| TRHDX | Data Hold After RD | 0 | | ns | 0 | | ns |
| TRHDZ | Data Float After RD | | 97 | ns | | 2TCLCL-70 | ns |
| TLLDV | ALE To Valid Data In | | 517 | ns | | 8TCLCL-150 | ns |
| TAVDV | Address To Valid Data In | | 585 | ns | | 9TCLCL-165 | ns |
| TLLWL | ALE To WR or RD | 200 | 300 | ns | 3TCLCL-50 | 3TCLCL-50 | ns |
| TAVWL | Address To WR or RD | 203 | | ns | 4TCLCL-130 | | ns |
| TWHLH | WR or RD High To ALE High | 43 | 123 | ns | TCLCL-40 | TCLCL+40 | ns |
| TDVWX | Data Valid To WR Transition | 0 | | ns | 0 | | ns |
| TOVWH | Data Setup Before WR | 433 | | ns | 7TCLCL-150 | | ns |
| TWMOX | Data Hold After WR | 33 | | ns | TCLCL-50 | | ns |
| TRLAZ | Address Float After RD | | 0 | ns | | 0 | ns |

The external RAM IC31, 6116LP-4 is a battery-back-up video RAM. When nothing is write-in/read-in from CPU, it is separated from CPU by bus driver IC34 (LS245) and multiplexer IC's 20, 24, 25 (LS157) to be directly accessed by the video timing generating circuit.

When addresses 6000H-67FFH are sent from CPU, each LS157 selects addresses on the CPU side. While WR pulse or RD pulse is sent, EN of LS245 is set to L level and P0 (BUS) of CPU is connected to the I/O port of 6116LP-4 so that 6116LP-4 can be accessed from CPU. The output of P10 from CPU switches page-1/page-2 of the screen.

[PROBLEMS]

1. Random characters are displayed on the screen but the function parameter or the characters typed in from the keyboard are not displayed properly.
 - 1) Check IC20 (LS157), IC24 (LS157), IC25 (LS157), IC1 (LS08), IC13 (LS32) and IC47 (LS04).
 - 2) Check IC34 (LS245).
 - 3) Check IC31 (6116LP-4).
2. Text in the battery-back-up memory is damaged.
 - 1) Check the batteries.
 - 2) Check the battery-back-up circuit and the reset circuit.

8-3 Interface

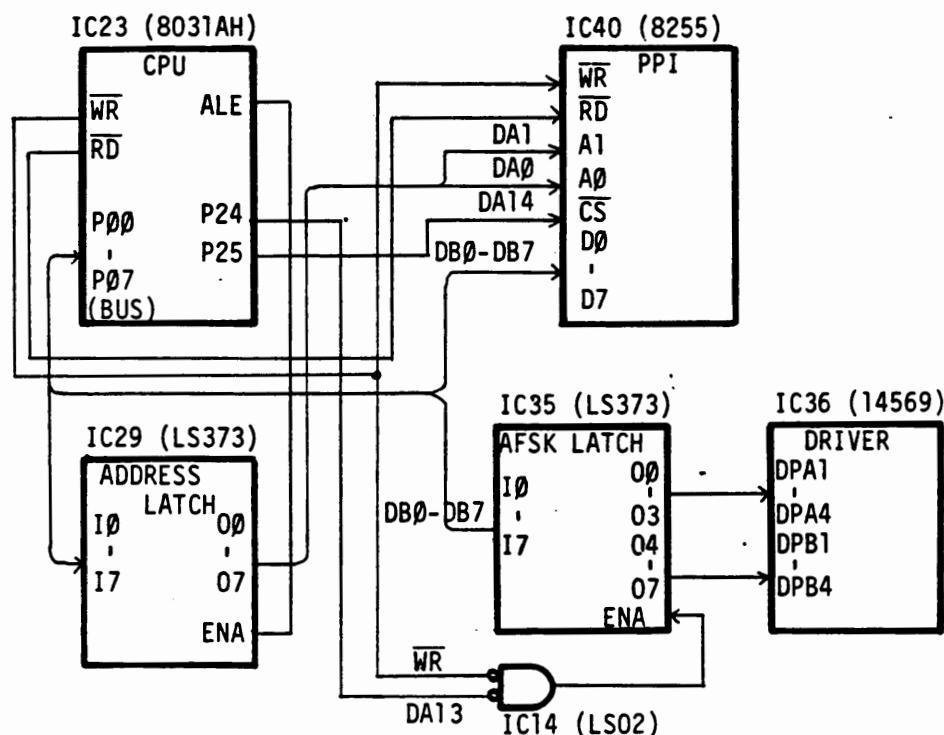
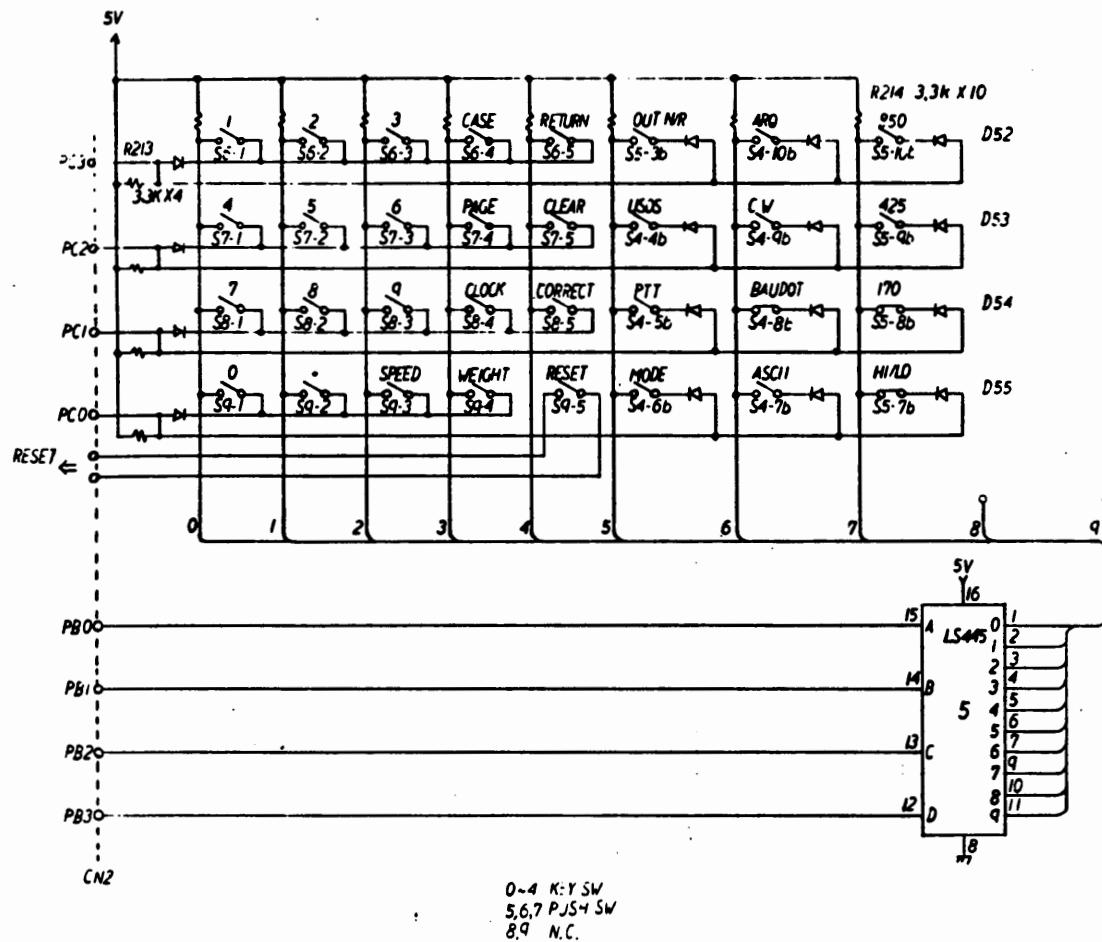


Fig. 8-5

IC40 (8255) is a programmable peripheral interface. When CPU outputs address $0A000H-0A003H$, 8255 becomes to be accessed, and the writing data in 8255 from CPU or reading data in CPU from 8255 is enabled. The waveform is the same as shown in Fig. 8-4.

IC35 (LS373) is a latch to memorize the dividing ratio for the AFSK generator. When CPU outputs $0C000H$ address to enable the writing-in (WR pulse is sent), IC14 (LS02) becomes select status and the data from CPU is latched to IC35 (LS373).

9. FRONT PANEL KEYBOARD, SWITCH BOARD



The pressing of the key switches and push buttons on the front panel is read in CPU through the same circuit by scanning. PB0-PB3 of 8255 outputs the number of a line which has a key desired to be read-in by BCD, which is decoded by IC5 (LS145 or LS445). The level of the line is set to L level and the rest to H level. In this case, the reading-in of PC0-PC3 enables CPU to see the state of the line. If any one key is pressed then, either of PC0-PC3 which is on the same line with the pressed key set to L level and the others to H level.

[PROBLEMS]

1. The keystroke of a specific key or switch is not read-in. → Check the key or switch. and Check D52-D55.
2. The keystroke of a specific group of keys or switches is not read-in. → Check IC5 (LS145), D52-D55, PB0-PB3 and PC0-PC3 of IC40 (8255).
3. No keystroke of any keys or switches is read-in. → Check IC5 (LS145) and IC40 (8255).

Check if CN2 is defective of contact.

10. CLOCK

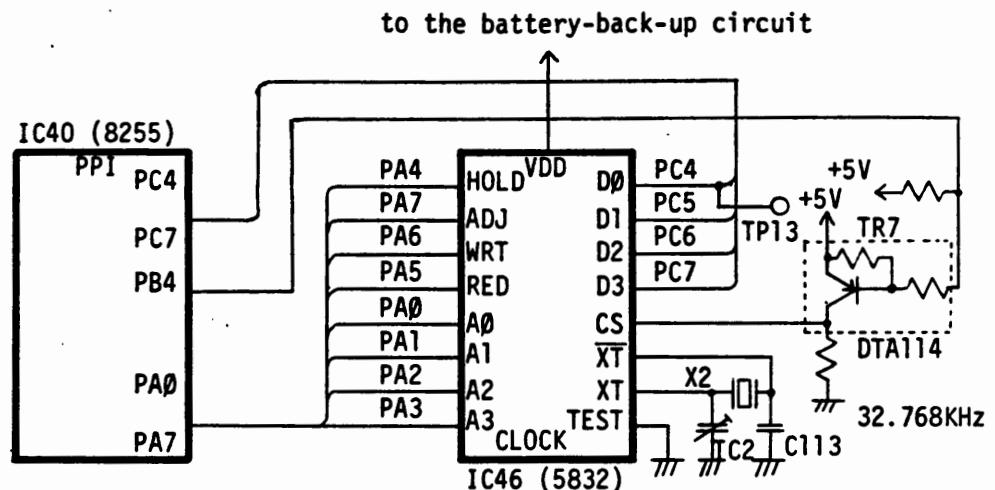


Fig. 10-1 Real Time Clock

The real time clock IC46 (5832) is backed up by batteries so that works even when the main power source is turned off. IC46 is controlled by IC40 (8255). The function table of IC46 (5832) is as shown in Fig. 10-1. When the RESET button is pressed, each port of IC40 (8255) becomes in high impedance state and TR7 (DTA114) becomes OFF state. Thus CS of IC46 becomes Low level and in disselect state, so the data in IC46 is protected. The gaining or losing time of the clock can be adjusted with TC2. For the adjustment, follow the procedure below;

- 1) Input **CLOCK + . + FUNC** from the front panel to give the 1024Hz output to TP18.
- 2) Connect a frequency counter of high accuracy to adjust TC2 to get TP18 precisely at 1024Hz.

| Address Input | | | | Internal Counter | Data I/O | | | | Count Value | |
|---------------|----|----|----|------------------|----------|----|----|----|------------------|--|
| A0 | A1 | A2 | A3 | | D0 | D1 | D2 | D3 | | |
| 0 | 0 | 0 | 0 | S1 | * | * | * | * | 0 - 9 | S1 and S10 enable WRITE to zero regardless to input data of D0-D3 when WRITE is enabled by selecting the address. READ is enabled by the or inary operation. |
| 1 | 0 | 0 | 0 | S10 | * | * | * | * | 0 - 5 | |
| 0 | 1 | 0 | 0 | M11 | * | * | * | * | 0 - 9 | |
| 1 | 1 | 0 | 0 | M10 | * | * | * | | 0 - 5 | |
| 0 | 0 | 1 | 0 | H1 | * | * | * | * | 0 - 9 | |
| 1 | 0 | 1 | 0 | H10 | * | * | * | ° | 0 - 1 / 0 - 2 | D2=P.M. by "H", D2=A.M. by "L" D3=total 24 hours by "H" D3=total 12 hours by "L" |
| 0 | 1 | 1 | 0 | W | * | * | * | | 0 - 6 | |
| 1 | 1 | 1 | 0 | D1 | * | * | * | * | 0 - 9 | |
| 0 | 0 | 0 | 1 | D10 | * | * | ° | | 0 - 3 | D2=leap year by "H", 29 days for February D2=28 days for February by "L" |
| 1 | 0 | 0 | 1 | M01 | * | * | * | * | 0 - 9 | |
| 0 | 1 | 0 | 1 | M010 | * | | | | 0 - 1 | |
| 1 | 1 | 0 | 1 | Y1 | * | * | * | * | 0 - 9 | |
| 0 | 0 | 1 | 1 | Y10 | * | * | * | * | 0 - 9 | |

NOTES: 1 When a leap year is set, the setting is canceled after the 29th of February is over.

2 Regarding D0-D3,

1) * = 0 or 1

2) ° = AM/PM, 12-hours/24-hours, a bit (0 or 1) for a leap year

3) blank column = no bit

[PROBLEMS]

- Not set as instructed from the keyboard, or no display of correct numerical value.

↓
Check PA0-PA7, PB4 and PC4-PC7 of IC40 (8255).
Check IC46 (5832) and TR7 (DTA114).

- The display of time doesn't go forward.

↓
Check IC46, TC2 and X2.

- No adjustment of gaining/losing time available.

11. PRINTER PORT

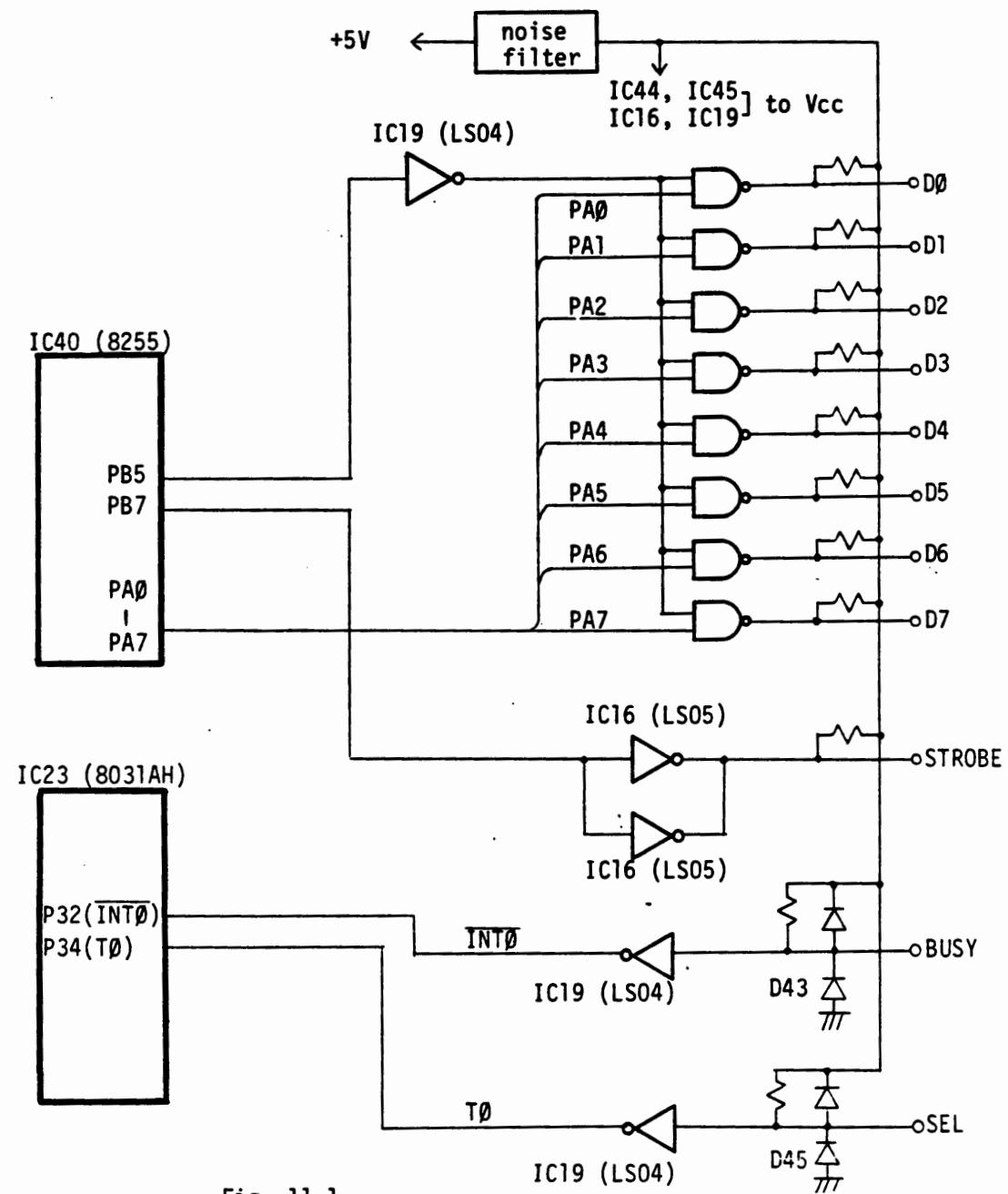


Fig. 11-1

The power source for IC44 (LS03), IC45 (LS03), IC16 (LS05) and IC19 (LS04) used as the input/output buffer of the printer port is provided with power through a noise filter to keep the spurious radiation at low rate. As PA0-PA7 of IC40 (8255) are used to control the real time clock IC46 (5832), PB5 of IC40 controls the gate of IC44 and IC45 not to output unnecessary data to D0-D7. Only the STROBE output is designed to be the parallel output of LS05 to increase the fan out, since usually the pull-up resistor of STROBE input of a printer is small.

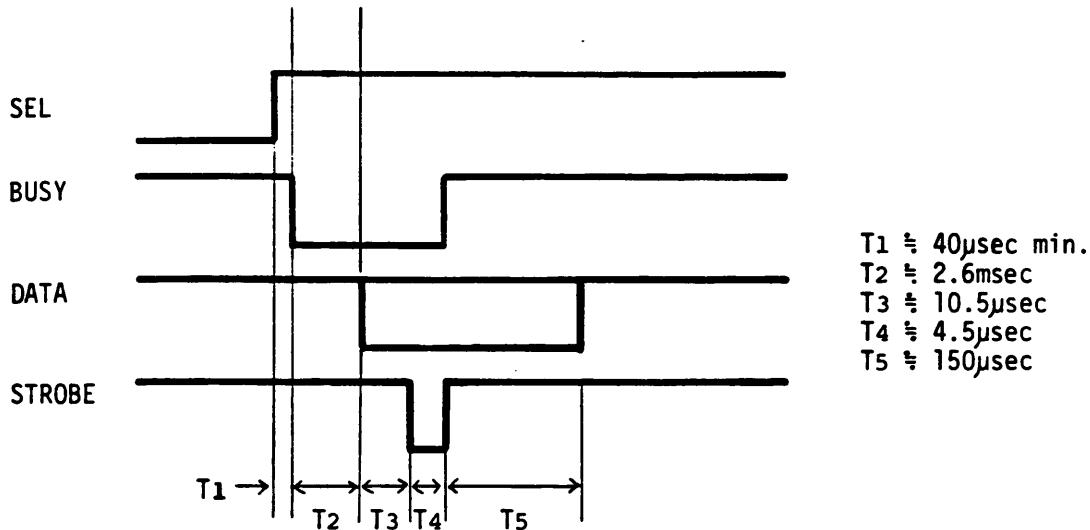


Fig. 11-2 Printer Port Timing

[PROBLEMS]

1. Misprints characters though the electric characteristic and the timing of the printer interface is compatible.

↓

Check IC40 (8255), IC44 (LS03) and IC45 (LS03).
Check if CN4 is defective or contact.

2. No printing of characters though the electric characteristic and the timing of the printer interface is compatible.

↓

Check if the BUSY signal and the SELECT signal are correctly conveyed
from BUSY (no. 21 pin of CN4) to P32 of CPU (no. 12 pin, $\overline{\text{INT}}\theta$),
from SEL (no. 25 pin of CN4) to P34 of CPU (no. 14 pin, $\overline{T}\theta$)
respectively.

↓

-Check IC19 (LS05)-

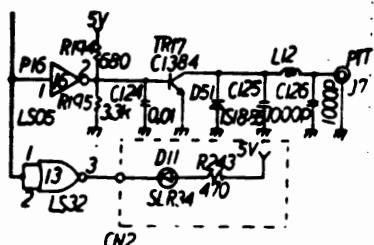
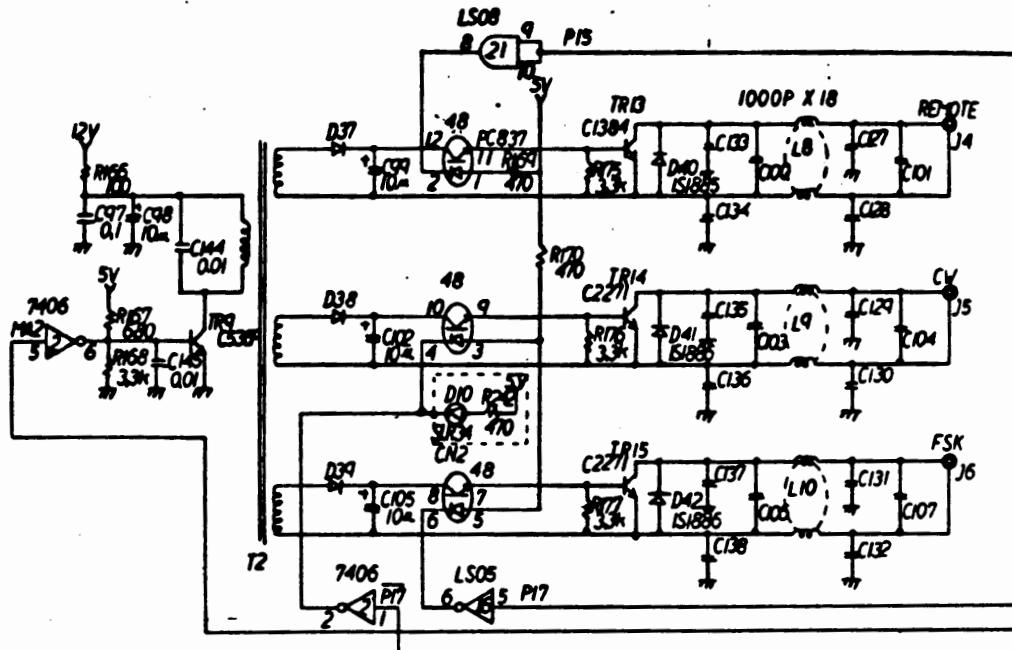
Check if the STROBE pulse is emitted .

↓

-Check IC16 (LS05) and IC40 (8255)-

Check if the data is sent. ————— -Check IC44 (LS03), IC45 (LS03), IC19 (LS04) and IC40 (8255)-

12. KEYING CIRCUIT



NOTE: Diodes are 1S1588 unless otherwise specified.

Fig. 12-1

The keying circuits of REMOTE, CW and FSK are floated by the optoisolator over the ground. The power is supplied to each photo transistor through the secondary winding of T2. T2 is driven by TR9 (2SC536) at 125 KHz. The PTT keying circuit works only when plus voltage is added, for the circuit uses emitter grounded NPN transistor: 2SC1384 of TR17.

[PROBLEMS]

1. A certain circuit among REMOTE, CW and FSK circuits does not work.

Check the following components of the circuit not working:
Keying Transistor, Protective Diode, Optoisolator, Secondary Supply Voltage*, ICs which drive optoisolator.

* It is not defective if the voltage is over 2V when the keying circuit is ON.

2. None of REMOTE, CW and FSK circuits works.

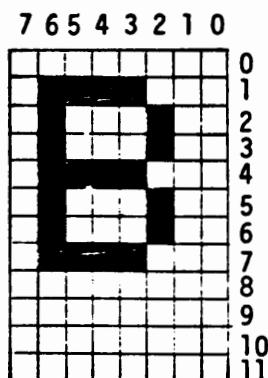
Check IC2 (7406), TR9 (2SC536) and check if the primary winding has disconnection or short circuits.

3. PTT circuit may be defective.

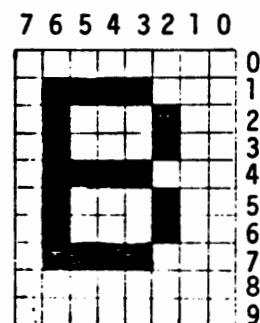
Check TR17 (2SC1384), D51 and IC16 (LS05).

13. VIDEO CIRCUIT

13.1 Character Font



Vertical Synchronizing
Frequency: 50 Hz



Vertical Synchronizing
Frequency: 60 Hz

Fig. 13-1

In case the vertical synchronizing frequency is 50 Hz, a character font occupies a 5 x 7 dot element in the 8 x 12 dot character matrix box.
In case of 60 Hz, a character font occupies a 5 x 7 dot element in the 8 x 10 dot character matrix box.

13.2 Screen Format

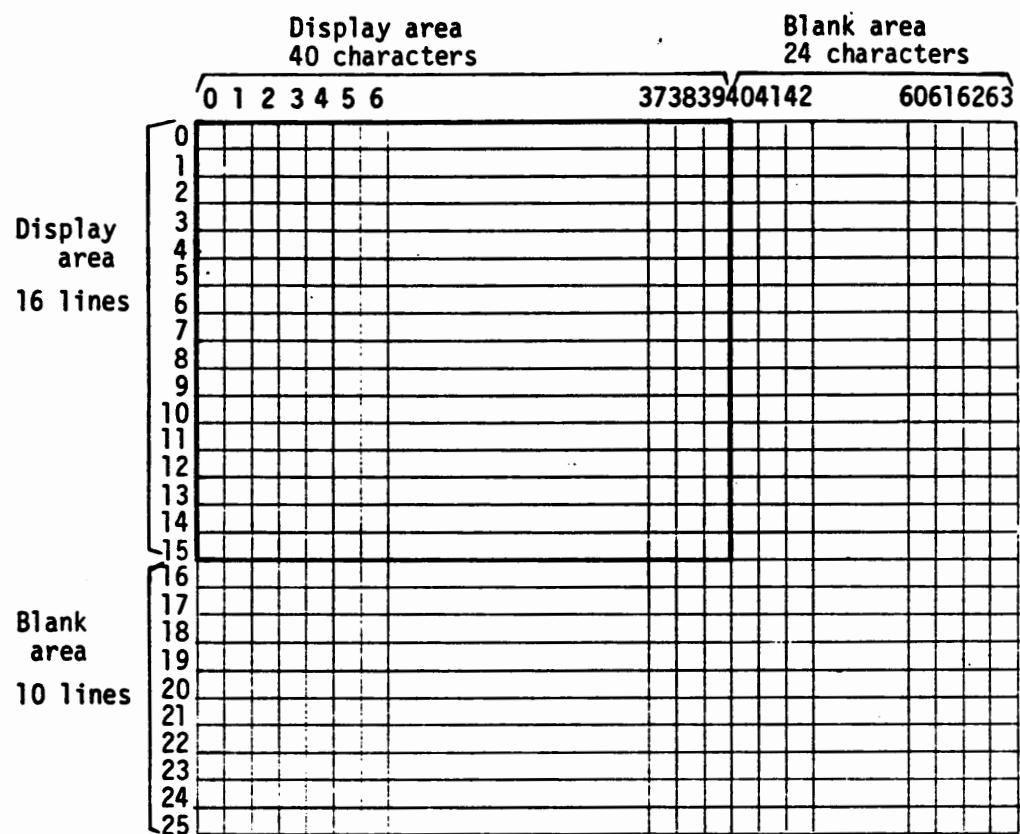
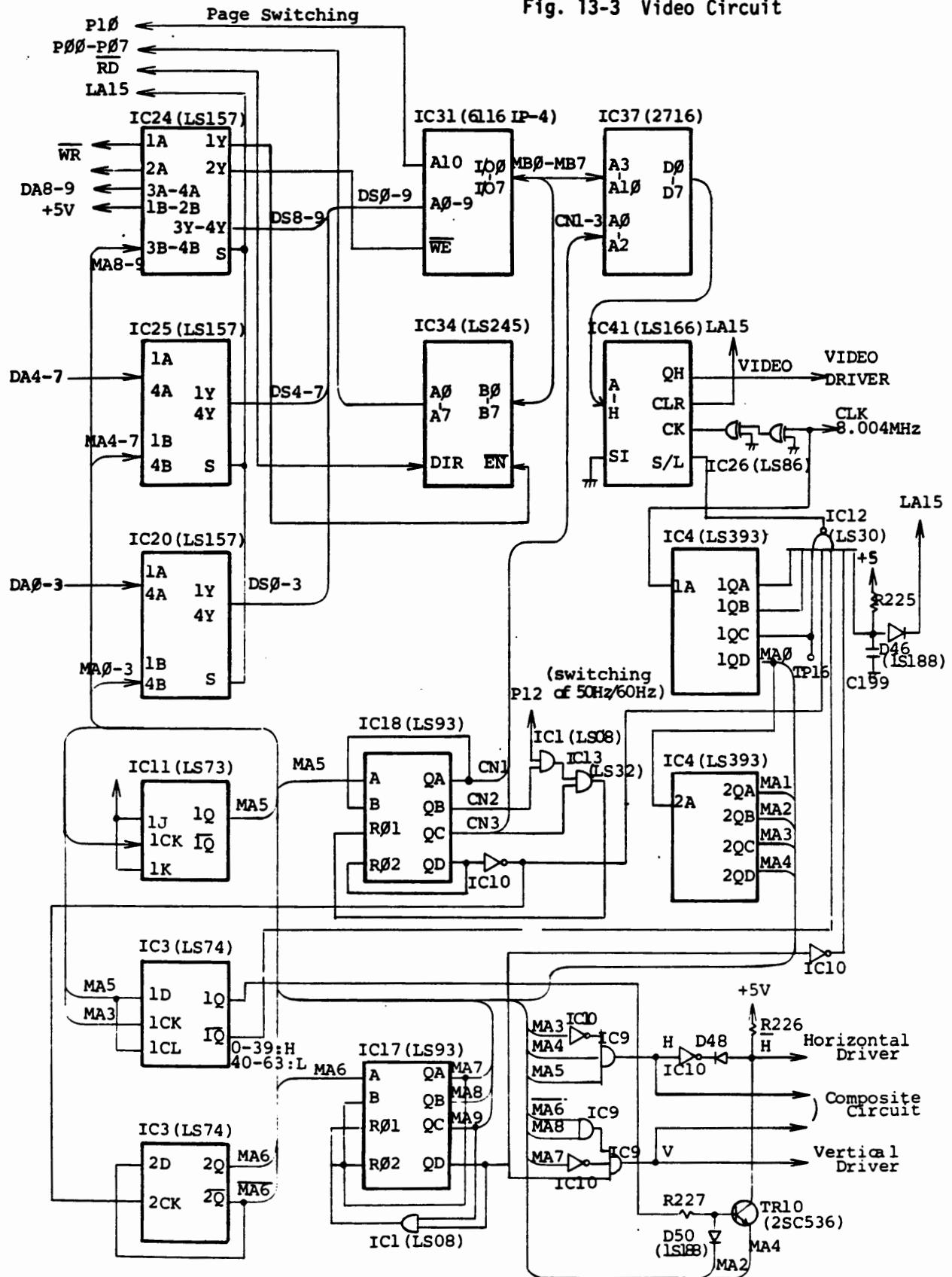


Fig. 13-2 Screen

A page of the screen consists of 40 characters x 16 lines.
The Theta-5000E provides 2 pages.

13-3 Video Signal Generating Circuit

Fig. 13-3 Video Circuit



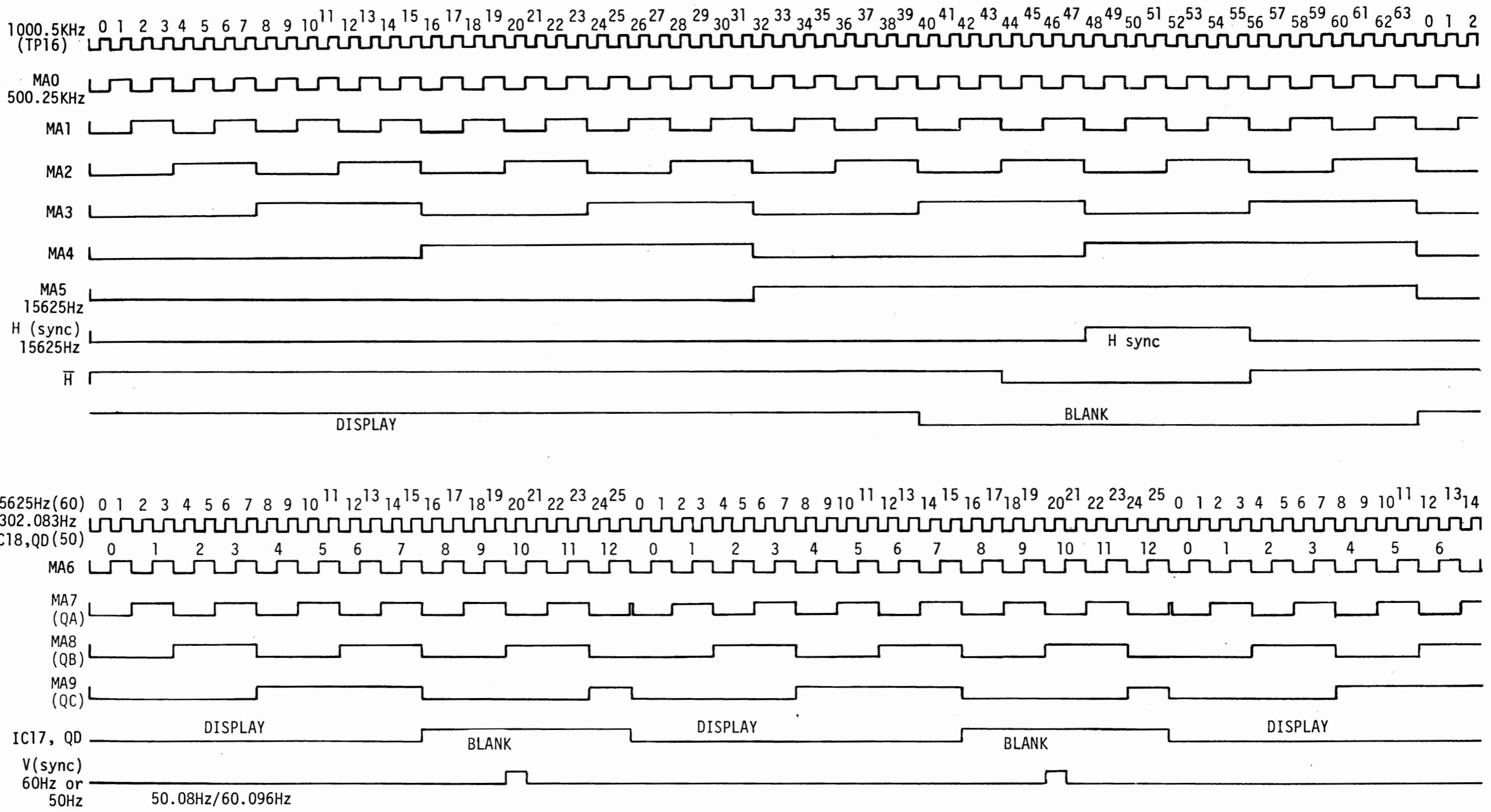


Fig. 13-4 Synchronizing Signal Timing Chart

(INTENTIONALLY LEFT BLANK)

The address signals DS₀-DS₉ are provided to the address lines of IC31 (6116 LP-4). When IC31 is not accessed by CPU, DS₀-DS₉ are connected to the address lines MA₀-MA₉ which are produced in the video timing generation circuit through the multiplexer IC's 20, 24, 25.

The I/O terminal of IC31 (6116LP-4) outputs ASCII, JIS or graphic pattern code which is in the memory for the address specified by DS₀-DS₉ connected to the address lines A₃-A₁₀ of IC37 (2716). The address lines A₀-A₂ of IC37 are connected to the output CN1-CN3 of the row scan counter IC18 (LS93). The output port D₀-D₇ of IC37 are connected to the shift resistor for the video signal generation and made parallel/series conversion.

To IC12 (LS03), the octal data of IC4 (LS393) and the display duration signal are provided, and the load signal is sent to the shift resistor IC41 (LS166) every eight clock in the display duration.

A divide-by-64 counter is contructed by 1QD (MA₀) - 2QD (MA₄) of IC4 (LS393) and 1Q (MA₅) of IC11 (LS73), whose output is synthesized at IC9 (LS11) and IC10 (LS04) to produce the horizontal synchronous signal H for the composite signal. IC3 (LS74) is a flip flop for generating the horizontal display duration signal and the display is activated between the counter value 0-39 of the divide-by-64 counter, and between 40-63 is left blank.

The horizontal synchronous signal H for the built-in monitor is synthesized by R226, R227, D48, D50, TR10 and IC10 (LS04). IC18 (LS93) is a counter for the row scan which becomes a decade counter by IC1 and IC13 when P12 of CPU is High level, in which case the number of vertical elements for one character will be 10 and the vertical synchronous signal will be 60Hz. In case P12 of CPU is Low level, it becomes a divide-by-12 counter in which case the number of vertical elements for one character will be 12 and the vertical synchronous signal will be 50Hz.

A divide-by-26 counter is consist of 2Q (MA₆) of IC3 (LS74), IC17 (LS93) and IC1 (LS08), whose output is synthesized at IC9 (LS11) and IC10 (LS04) to obtain the vertical synchronous signal V. The vertical display duration signal is obtained from QD of IC17 (LS93). The display is activated between the counter value 0-15 of the divide-by-26 counter and 16-25 is left blank.

13.4 Video Driver Circuit • Composite Video Circuit

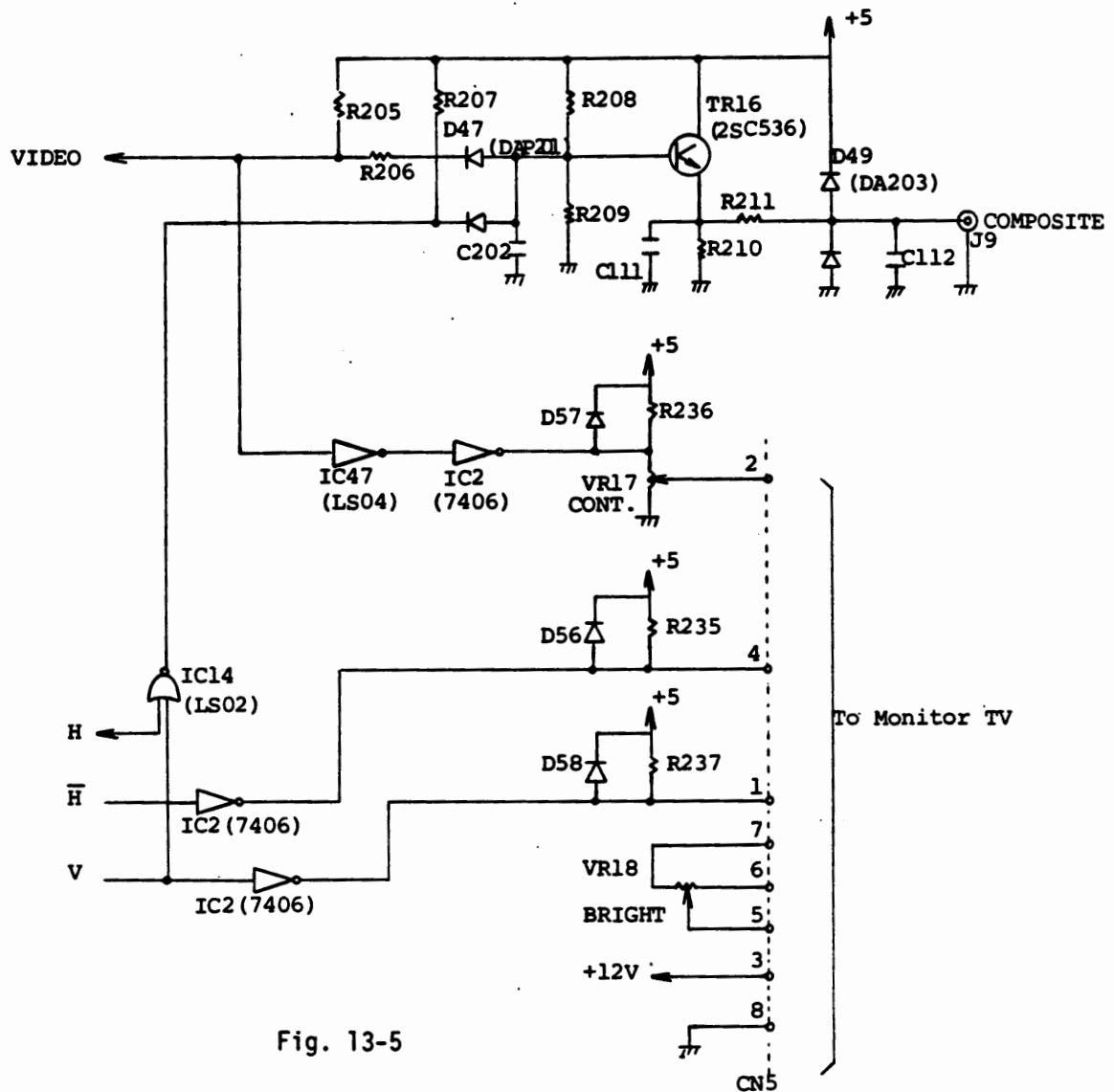


Fig. 13-5

Each of the VIDEO, \bar{H} and V signals obtained from the video signal generating circuit is sent to the built-in monitor TV through the driver IC2 (7406). VR17 is a variable resistor for contrast adjustment, VR18 is a variable resistor for brightness adjustment. An +12VDC power is supplied from CN5 to drive the built-in monitor.

H and V signals are synthesized at IC14 (LS02) and are sent together with the VIDEO signal to the composite signal synthesizing circuit which consists of D47 (DAP201) and TR16 (2SC536).

[PROBLEMS]

- Proper display on the built-in monitor screen but no COMPOSITE signal output.

Check IC14 (LS02), D47 (DAP201), TR16 (2SC536) and the arounds.

2. No display on the built-in monitor screen but proper COMPOSITE signal output.
 - 1) Check IC2 (7406), VR17 and VR18. Check if CN5 is defective or contact or down.
 - 2) Check the built-in monitor.
3. No display on the built-in monitor screen, nor the COMPOSITE signal output.

Check if the horizontal and vertical synchronizing signal are sent properly.

↓OK ↓NO

Check the VIDEO signal circuit -
IC20 (LS157), IC24 (LS157),
IC25 (LS157), IC31 (6116LP-4),
IC32 (2716) and IC41 (LS166).
4. Two data or more are displayed horizontally when one data is to be displayed on the screen.

Check IC4 (LS393), IC11 (LS73), IC9 (LS11) and IC10 (LS04).
5. Two data or more are displayed vertically when one data is to be displayed on the screen.

Check IC18 (LS93), IC3 (LS74), IC17 (LS93), IC9 (LS11) and IC10 (LS04).
6. Horizontal synchronization or vertical synchronization can not be obtained.

Check the circuit for synthesizing the synchronizing signal which consists of IC9 (LS11) and IC10 (LS04), and the arounds.

SPARE PARTS LIST

I C

| CODE NO. | NAME | DESCRIPTION |
|---------------|----------|-----------------------------|
| IC 1 | 8031 | CPU |
| IC 2, 12 | LS373 | TTL |
| IC 3 | LS245 | " |
| IC 4 | 27128 | EPROM (PROGRAM MEMORY) |
| IC 5 | LS145 | TTL |
| IC 6, 7, 8 | LS157 | " |
| IC 9 | LS73 | " |
| IC 10 | LS74 | " |
| IC 11 | 8255 | PPI |
| IC 13 | 6116LP-4 | CMOS RAM |
| IC 14, 15 | LS93 | TTL |
| IC 16 | 5832 | REAL TIME CLOCK |
| IC 17 | 14569 | CMOS LOGIC |
| IC 18 | LS166 | TTL |
| IC 19 | 2716 | EPROM (CHARACTER GENERATOR) |
| IC 20 | LS393 | TTL |
| IC 21, 22 | LS03 | " |
| IC 23, 33, 35 | LS04 | " |
| IC 24 | LS11 | " |
| IC 25 | LS30 | " |
| IC 26 | LS00 | " |
| IC 27 | LS08 | " |
| IC 28 | LS02 | " |
| IC 29 | LS32 | " |
| IC 30 | LS51 | " |
| IC 31 | LS86 | " |

| <u>CODE NO.</u> | <u>NAME</u> | <u>DESCRIPTION</u> |
|-----------------|-------------|-----------------------|
| IC 36 | LS05 | TTL |
| IC 37 | 7406 | " |
| IC 38, 50 | 14051 | CMOS LOGIC |
| IC 39, 40, 41 | 14066 | " |
| IC 42, 43 | 3900 | OP. AMP. |
| IC 44, 45, 46 | 324 | " |
| IC 47 | 339 | COMPARATOR |
| IC 48, 49 | LB1405 | LEVEL METER |
| IC 51, 52 | 14052 | CMOS LOGIC |
| IC 53 | 7805 | 5V VOLTAGE REGULATOR |
| IC 54 | 7812 | 12V VOLTAGE REGULATOR |
| IC 55 | 14021 | CMOS LOGIC |
| IC 56 | 14094 | " |
| IC 57 | 14068 | " |
| IC 58 | 14007 | " |
| IC 59 | PC837 | OPTOISOLATOR |
| IC 60 | BA546 | AUDIO AMP. |

DIODE

| <u>CODE NO.</u> | <u>NAME</u> | <u>DESCRIPTION</u> |
|----------------------------------|---------------|----------------------|
| D 1, 13-16, 28, 43 45, 49 | DA203 | DIODE ALLEY |
| D 2-4, 23, 26-29 33-39, 56-58 | 1S1588, DS448 | " |
| D 5, 12 | RD3.3EB | ZENOR DIODE |
| D 6, 7 | SLP-169B | LIGHT EMISSION DIODE |
| D 8, 9 | SLP-139B | " |
| D 10, 11 | SLR-34UR | " |

| <u>CODE NO.</u> | <u>NAME</u> | <u>DESCRIPTION</u> |
|-------------------------------|-------------|--------------------|
| D 17-22, 24, 25 46, 48, 50 | 1S188FM | DIODE |
| D 30 | DBA30 | BRIDGE |
| D 32 | RD30EC | ZENOR DIODE |
| D 40-42, 51 | 1SR35-200VL | DIODE |
| D 47 | DAP201 | DIODE ALLEY |
| D 52-55 | DAP601 | " |

TRANSISTOR

| <u>CODE NO.</u> | <u>NAME</u> | <u>DESCRIPTION</u> |
|----------------------|-------------|--------------------|
| TR 1-3, 5, 9, 10, 16 | 2SC536F | TRANSISTOR |
| TR 4 | 2SA1015Y | " |
| TR 7 | DTA114 | " |
| TR 13, 17 | 2SC1384 | " |
| TR 14, 15 | 2SC2271E | " |

COIL

| <u>CODE NO.</u> | <u>NAME</u> | <u>DESCRIPTION</u> |
|-----------------------|-------------|----------------------------|
| L 1, 6, 7, 12, 13, 19 | C4433 | INDUCTOR |
| L 8, 9, 10 | C4519 | TROIDAL COIL |
| L 11, 14, 15 | 42724 P821K | FIXED INDUCTOR 820 μ H |
| L 16, 17 | C3637A | TROIDAL COIL |
| L 18 | C4447 | CHOKING COIL |

VARIABLE RESISTOR

| CODE NO. | NAME | DESCRIPTION | |
|--------------|--------------|-----------------------|-------|
| VR 1, 4 | 1021A 22K | TRIMMER POTENTIOMETER | 22K |
| VR 2 | " 10K | " | 10K |
| VR 3, 5-7 | " 4.7K | " | 4.7K |
| VR 8 | 179-5KB | VARIABLE RESISTOR | 5KB |
| VR 9, 13, 14 | 1021A 47K | HALF-FIXED VR | 47K |
| VR 10 | " 22K | " | 22K |
| VR 11 | " 10K | " | 10K |
| VR 12 | " 4.7K | " | 4.7K |
| VR 15 | 123P-N-10KB | VARIABLE RESISTOR | 10KB |
| VR 16 | 179N-10KA | " | 10KA |
| VR 17 | 123P-N-500B | " | 500 B |
| VR 18 | 123P-N-100KB | " | 100KB |

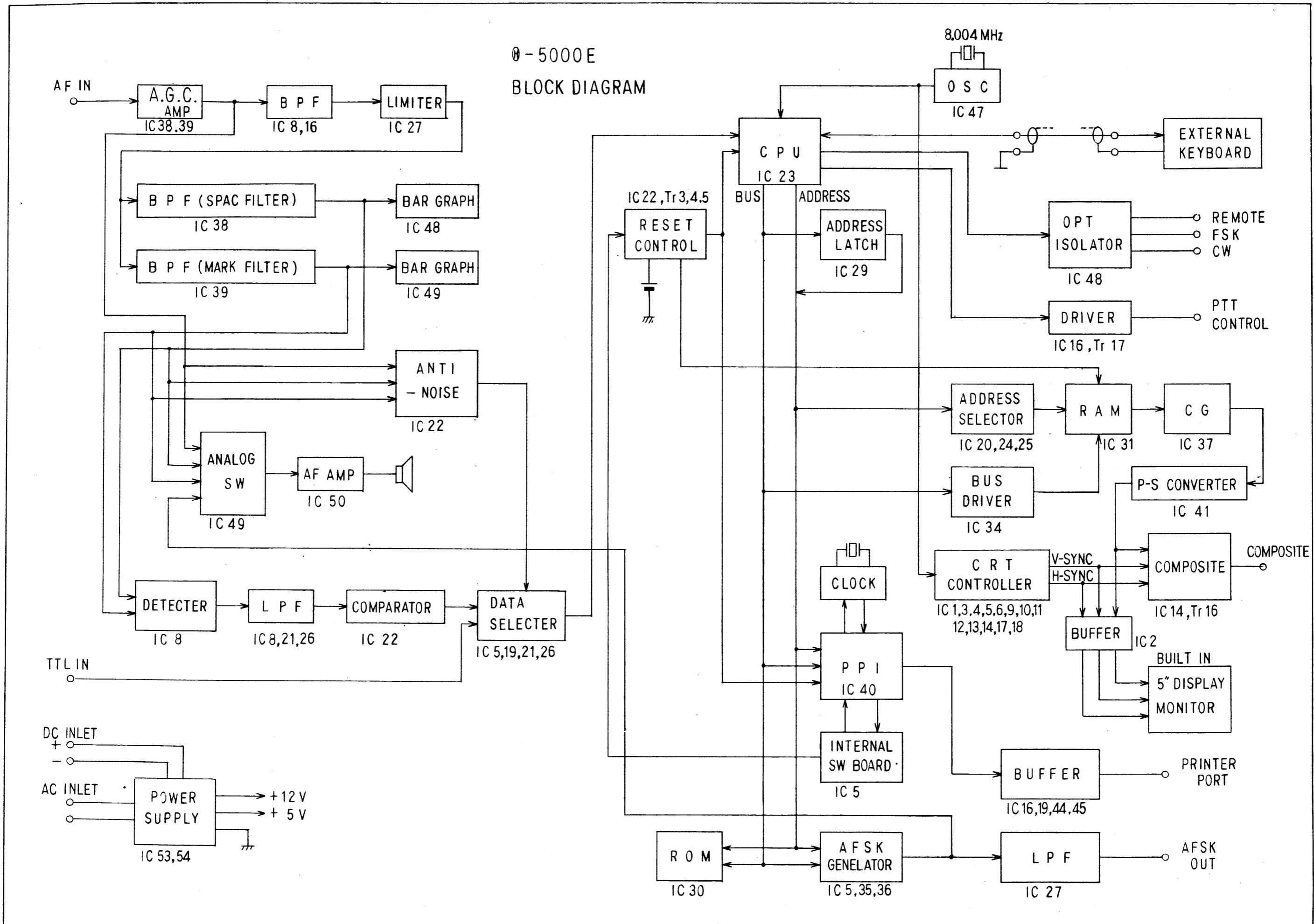
CONNECTOR

| CODE NO. | NAME | DESCRIPTION | |
|----------|------------------|---------------|-----|
| CN 1 | 5281-4A | WAFER | 4P |
| CN 2 | 1LG-10P | HEADER | 10P |
| CN 3 | 1LG-2G | " | 2P |
| CN 4 | JAE-34PE-D4T1-LT | BLOCK HEADER | |
| CN 5 | 5281-8A | WAFER | 8P |
| CN 6 | D6-729A-200 | DIN CONNECTOR | |
| CN 7 | 5281-2A | WAFER | 2P |
| CN 8 | 5281-3A | WAFER | 3P |
| CN 9 | 1LG-3P | HEADER | 3P |

OTHER PARTS

| CODE NO. | NAME | DESCRIPTION |
|----------|-----------|--------------------------|
| T 2 | C-4432 | OSCILLATION TRANSFORMER |
| T 3 | T40VA | POWER SOURCE TRANSFORMER |
| X 1 | 8MHZ | CRYSTAL |
| X 2 | 32.768KHZ | " |
| J 1-9 | SQ-3099 | PIN JACK |
| J 10, 11 | SQ-3063 | " |
| S 1 | SDU | POWER SWITCH |
| S 3 | JS5040 | VOLTAGE SWITCH |
| S 4 | SUZA1-U | 10-GEAR PUSH SWITCH |
| S 5 | SUZA1-L | " |
| S 6-9 | SPQ051D | 5-GEAR PUSH SWITCH |

NOTE: THE EQUIVALENT MAY BE MOUNTED IN THE UNIT IN PLACE OF ABOVE-MENTIONED PARTS.



DDC5NDG

DATA DISPLAY MONITOR CHASSIS

TECHNICAL MANUAL

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SAFETY PRECAUTION

WARNING : Service should not be attempted by anyone unfamiliar with the necessary precautions on this unit.

The following precautions are necessary during servicing.

1. Some parts such as a picture tube in this monitor have special safety-related characteristics for X-RAY RADIATION protection. For continued safety, the parts replacement should be undertaken referring to item 2 below.
2. Many electrical and mechanical parts in this unit have special safety-related characteristics for protection against shock hazard, fire hazard and others. These characteristics are often passed unnoticed by a visual inspection and the protection afforded by them cannot necessarily be obtained by using replacement components rated for higher voltage wattage, etc. Replacement parts which have these special safety characteristics are identified in this manual and its supplements marked with a Δ on the schematic diagram and the parts list. Before replacing any of these components, read the parts list in this manual carefully.
3. When replacing a chassis in the cabinet, always be certain that all the protective devices are installed properly, such as; insulating cover, barries, strain relief, etc.

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| | | DDC5NDG | 2/32 |

GENERAL DESCRIPTION

Model DDC5NDG is a 5.5-inch raster scan display monitor designed specifically for data terminals. This model designed for high quality display of the alphanumeric dot characters.

DDC5NDG accepts video, horizontal drive and vertical drive as separate TTL level signals.

The 100% solid state silicon circuitry provides cool operation and high reliability.

Features

- 5.5 inch CRT
- Direct etched non glare faceplate (option)
- 650 lines horizontal resolution
- Horizontal Video Center Control
- Compact chassis type for easy mounting

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| | | DDC5NDG | 3/32 |

SPECIFICATIONS

Mechanical (approx.)

Chassis Dimension 130 mm (W) x 113 mm (H) x 219 mm (D)

Weight

Net Weight 1.2 Kg.

Picture tube

Size & deflection 5.5 inch, 20.0 mm dia. neck, 70° deflection.

Faceplate 360 mm radius, direct etched non-glare faceplate.

Phosphor P 39 (GREEN)

Type C5M113P39

Controls

Width Coiled type mounted on PCB

Horiz. Video-center Rotary VR type mounted on PCB

Height Rotary VR type mounted on PCB

Vert. Linearity Rotary VR type mounted on PCB

Vert. Hold Rotary VR type mounted on PCB

Horiz. Linearity Coiled type mounted on PCB

Focus Rotary VR type mounted on PCB

Sub-Brightness Rotary VR type mounted on PCB

Contrast Rotary VR type mounted on Main PCB (Optional)

Brightness External, user supply

Raster centering Raster centering rings (magnet type) mounted on Deflection Yoke

Input Connector 10 pin cardedge board connector. (refer to attached Input Signal Interface)

Performance

Horiz. Resolution

Center 650 lines, nominal.

Corner 500 lines, nominal.

Video Bandwidth 12 MHz, nominal. (-3 dB)

Geometric Distortion ±2.5 %, nominal

±3.0 %, maximum.

Non-Linearity

Vertical 7 %, nominal.

10 %, maximum.

Horizontal 10 %, nominal

13 %, maximum

Display Area (Picture centering and tilt specified in Fig. 1 & 2 are Sanyo's timing.)

*Horizontal 92±5 mm

*Vertical 70±5 mm

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Electrical**Input Signal**

| | |
|-----------------------------|--|
| Video signal | 4 ± 1.5 Vpp thru 500 ohm contrast control VR, positive going white. |
| Horizontal drive | 4 ± 1.5 Vpp 5K ohms, positive going. |
| Vertical drive | 4 ± 1.5 Vpp 15K ohms, negative going. |
| **Horizontal rate | 15.25 KHz min. - 16.6 KHz max. |
| **Vertical rate | 49 to 61 Hz |
| Retrace time (nominal) | |
| Horizontal | 7.0 μ S |
| Vertical | 850 μ S |
| Power Requirement | DC 12V ± 0.1 V, regulated, 0.8A nominal 1.0A maximum Ripple 10 mVpp maximum |

Environmental**Temperature**

| | |
|---------------------|---------------|
| Operation | 0°C to 55°C |
| Storage | -20°C to 70°C |

Humidity

| | |
|---------------------|------------------------------|
| Operation | 10 % to 80 %, non-condensing |
| Storage | 10 % to 80 %, non-condensing |
| Altitude | Up to 10,000 ft (3,050 m) |

X-ray radiation Less than 0.5 mR/H

MTBF 30,000 hours, without CRT

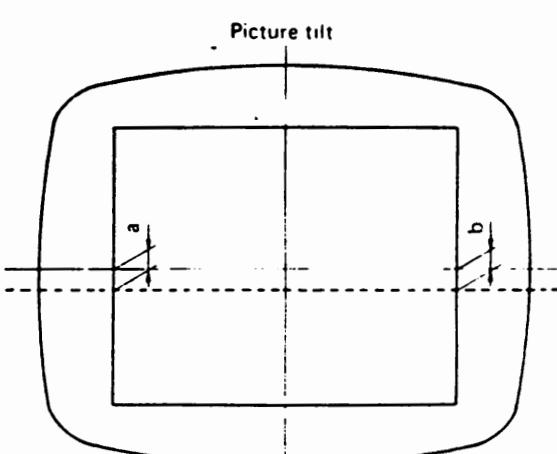
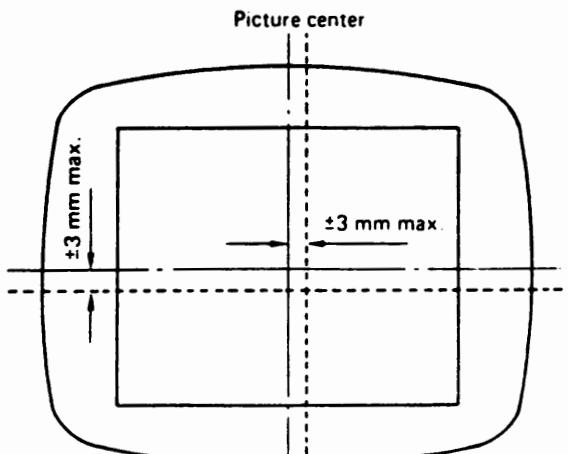
Factory adjusted ratePower Source DC 12 ± 0.1 V, regulated**Scanning Frequency (depend on timing chart)**

| | |
|----------------------|---------------|
| Vertical | 60 Hz |
| Horizontal | 16.6 KHz |
| Brightness | Raster cutoff |

NOTE: Items with "''" marks in this specifications indicate the Factory Adjusted Rates.

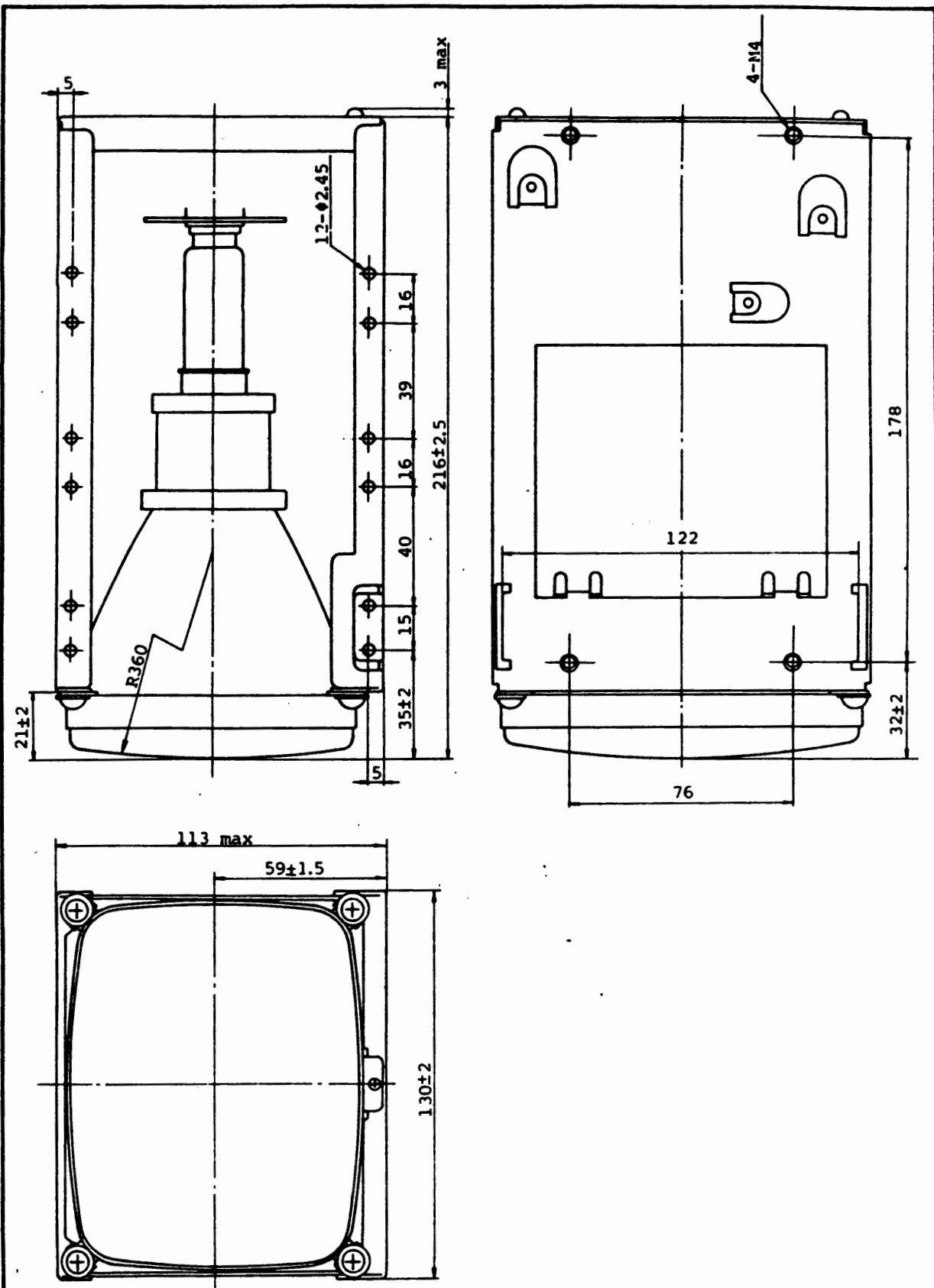
Items with "''' marks indicate Factory Timing. (Refer to Page 7)

Input Signal Format is specified on Page 8.

Picture centering & tilt

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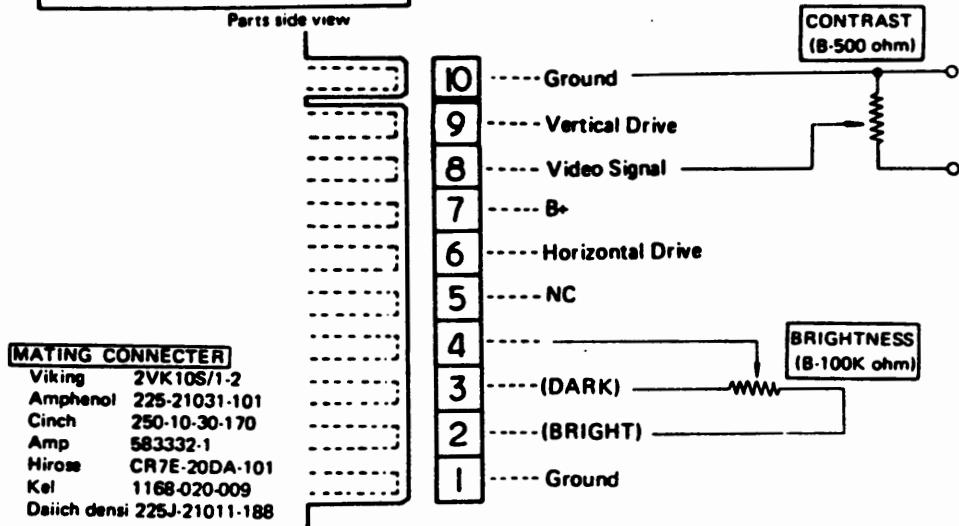


05MDK

Unit: mm
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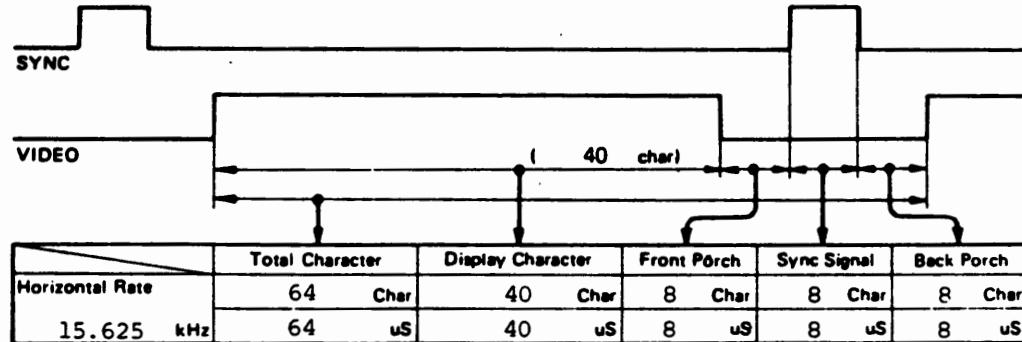
PIN CONNECTION



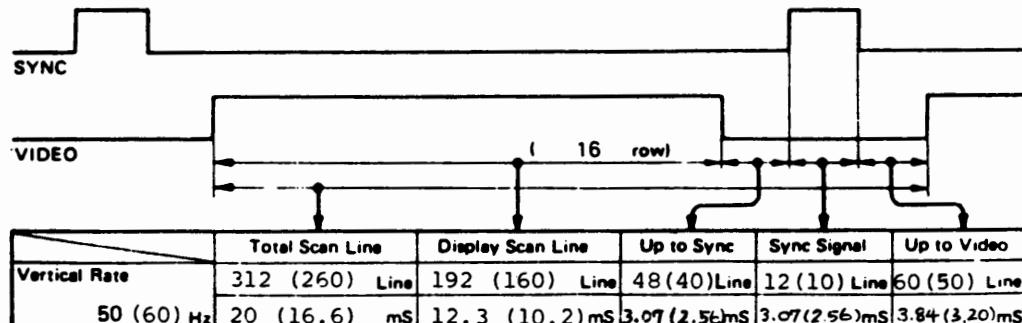
CHARACTER INFORMATION

| CHARACTER | 5 x 7 dots | DOT CLOCK | 8 MHz |
|-----------------|--|-----------------|-------|
| CHARACTER BLOCK | 50Hz : 8 x 12 dots 60Hz : 8 x 10 dots | CHARACTER CLOCK | 1 MHz |

HORIZONTAL TIMING



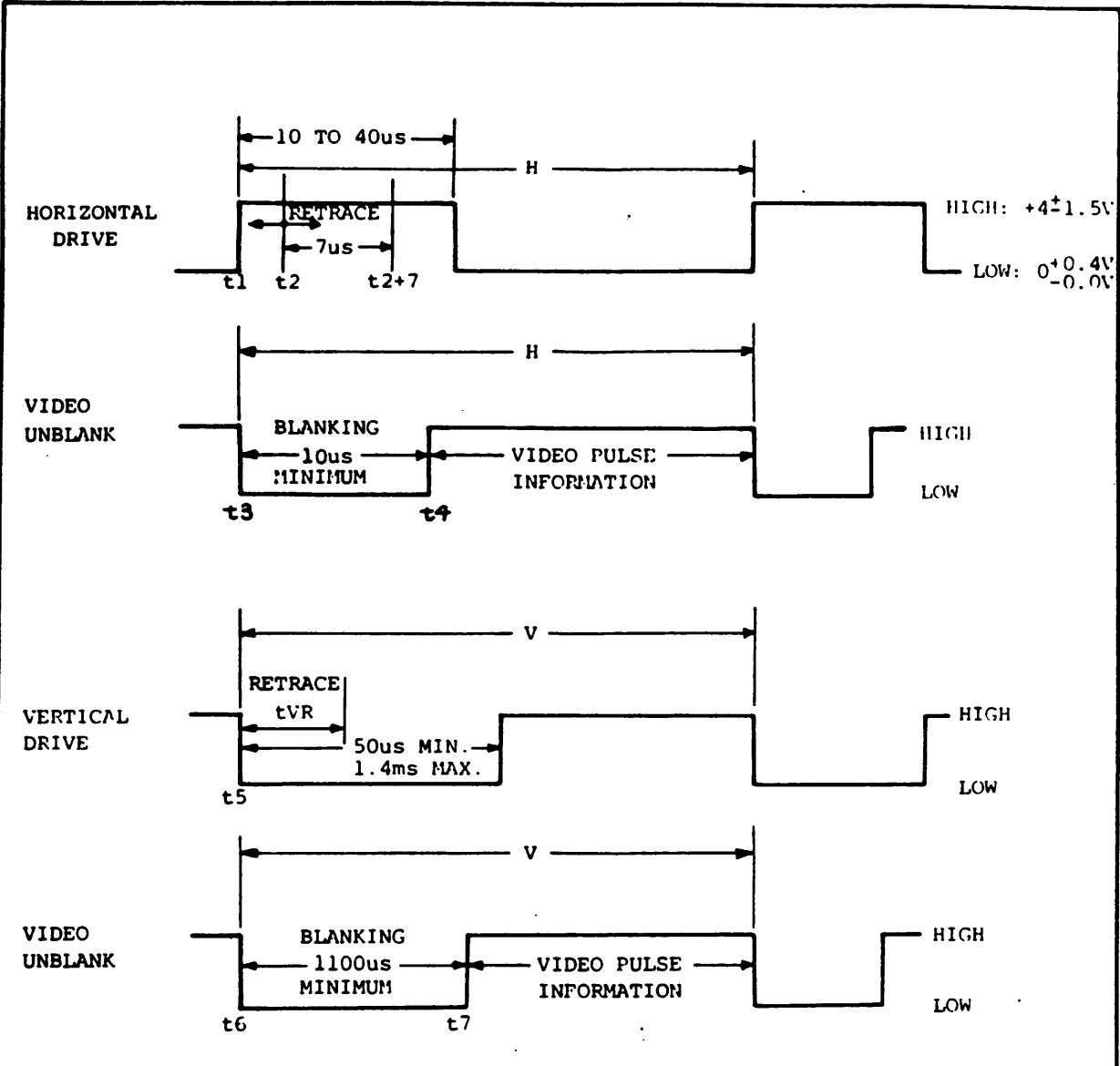
VERTICAL TIMING



Card No.-15

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NOTES:

1. HORIZONTAL RETRACE IS INITIATED AT t2 (1.5 TO 6.5 μ s AFTER t1, DEPENDING ON SETTING OF VR601)
2. H=PERIOD OF ONE LINE: 65.57 μ s MIN. TO 60.24 μ s MAX.
3. VERTICAL RETRACE IS INITIATED AT t5 WITHOUT DELAY.
4. V=PERIOD OF ONE FIELD: 16.4ms MIN. TO 20.4ms MAX.

TABLE 1. t3 VS t1 TIMING FOR CENTERED HORIZONTAL VIDEO AS FUNCTION OF H. BLANKING WIDTH

| HORIZONTAL VIDEO BLANKING | |
|---------------------------|-----------------------|
| WIDTH t4 - t3 | LEAD / LAG t1 - t3 |
| 10 | .50 TO 0 μ s |
| 12 | .40 TO 1.0 μ s |
| 14 | .30 TO 2.0 μ s |
| 16 | .20 TO 3.0 μ s |
| 18 | .10 TO 4.0 μ s |
| 20 | .0 TO 5.0 μ s |

TABLE 2. t6 VS t5 TIMING FOR CENTERED VERTICAL VIDEO AS FUNCTION OF V. BLANKING WIDTH

| VERTICAL VIDEO BLANKING | |
|-------------------------|-----------------------|
| WIDTH t7 - t6 | LEAD / LAG t5 - t6 |
| 1100 | 125 μ s |
| 1150 | 150 μ s |
| 1250 | 200 μ s |
| 1450 | 300 μ s |
| 1650 | 400 μ s |

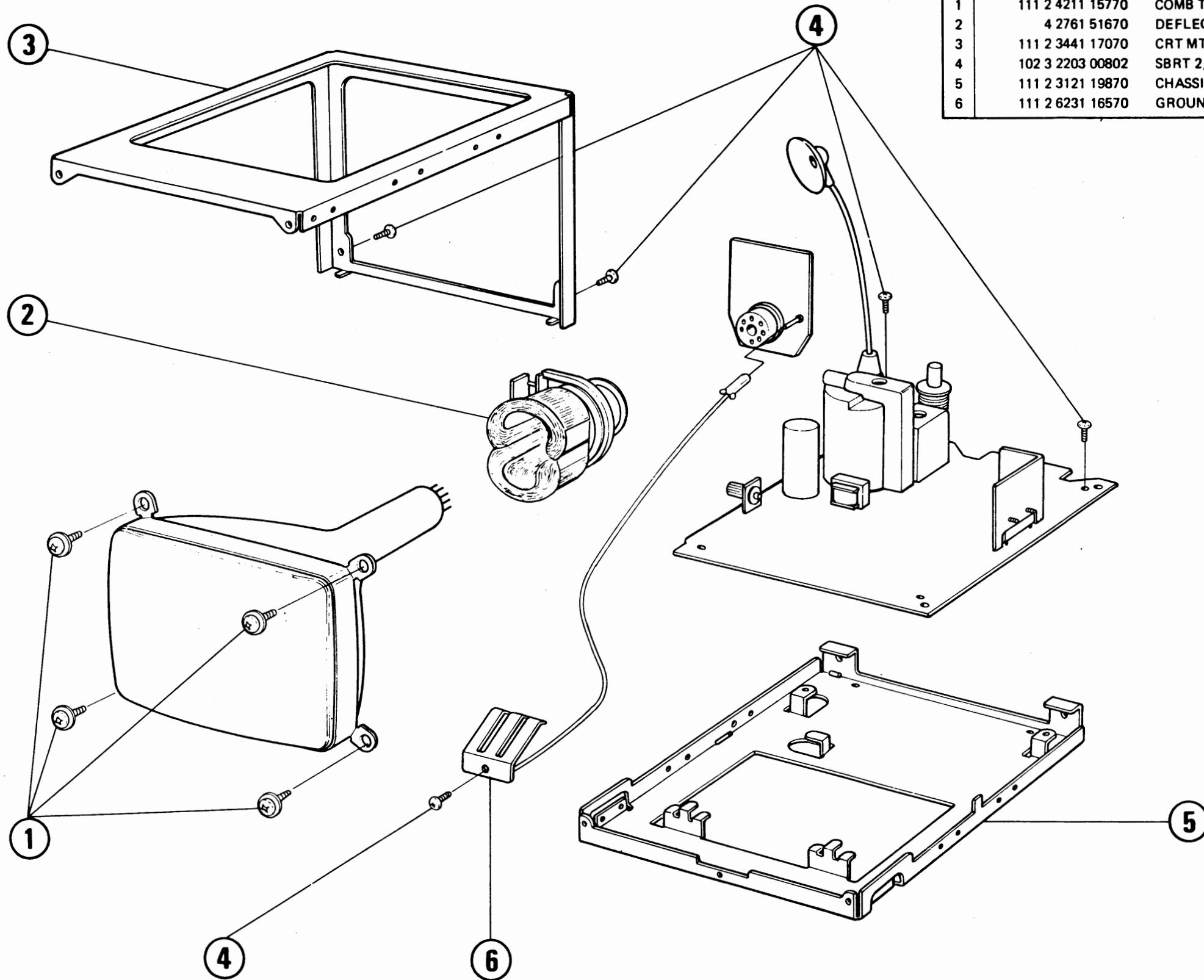
VERTICAL RETRACE TIME tVR = 850 μ s

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EXPLODED VIEW



| NO. | PART CODE | DESCRIPTIONS | Q'TY |
|-----|------------------|--------------------|------|
| 1 | 111 2 4211 15770 | COMB TAP SCREW-MBW | 1 |
| 2 | 4 2761 51670 | DEFLECTION YOKE | 1 |
| 3 | 111 2 3441 17070 | CRT MTG BRKT-MDK | 1 |
| 4 | 102 3 2203 00802 | SBRT 2, 3.0x8 Z1 | 5 |
| 5 | 111 2 3121 19870 | CHASSIS FRAME-MDK | 1 |
| 6 | 111 2 6231 16570 | GROUNDING TIP-MDK | 1 |

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CONTROLS on PCB

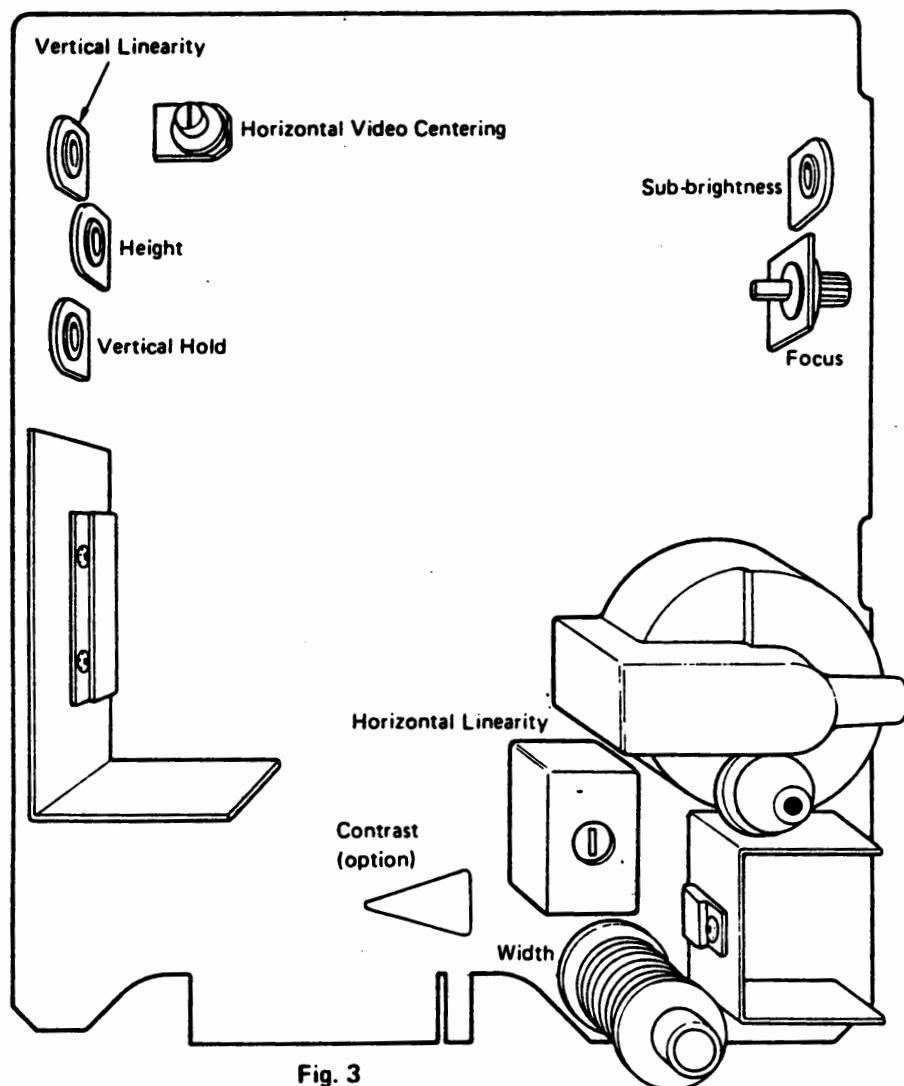


Fig. 3

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INSTALLATION

3-1. Safety Warning

- 1) Extreme care should be taken in handling the cathode ray tube as rough handling may cause it to implode. Any undue external pressure on glass, especially on the thin neck portion, should be avoided.
- 2) In case of CRT replacement, be sure to use the tube of the same type number as specified. The use of the cathode ray tube type other than the specified may cause possible increase of X-ray radiation.

3-2. Mounting

- A. It is recommended that all the Disk Portion is covered by silicon steel. In addition, it is an effective method to isolate between the Disk Portion and the FBT of the CRT Display Monitor by silicon steel. Special care should be taken when the Disk Portion is located on the right side.
- B. Any power transformer, power unit or switching regulator should be located well apart from CRT, Deflection Yoke, and the printed circuit board (especially the vertical and horizontal circuit) as the external flux field or noise may cause mal-effect on displayed picture stability.

3-3. Power Input

- The DC input power is applied through Pin 7 (B+) and Pin 1 (Ground) of 10-pin cardedge board connector.
- CAUTION:** A. As the picture size varies according to the variation of the voltage (Reference voltage: 12 V DC), the variation of ± 0.1 or less is desirable.
B. The use of power source with many ripples may cause mal-effect on displayed picture stability. The ripple of 10 mVpp or less is desirable.

3-4. Data Signal Input

- Apply data signal to each pin of 10-pin cardedge board connector. (Refer to Input Signal Interface.)
- CAUTION:** If the amplitude of the video signal is 2.0 Vpp (nominal) or more, use the contrast control (B-500 ohm VR) for gain adjustment. Otherwise, the displayed picture will be out of focus because the video amplifier is saturated.
- Some models are equipped with the contrast control on the p.c.b. Call the dealer for the details.

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3.5. Controls

- 1) The following controls are factory adjusted for the optimum, and user's readjustments are not required.

| Controls | PCB Marking | Location |
|----------------------|-------------|----------|
| Focus | FOCUS | VR652 |
| Width | | L602 |
| Vertical Linearity | V-LIN | VR503 |
| Horizontal Linearity | | L601 |
| Height | V-HEIGHT | VR502 |
| Centering | | DY |

- 2) Under listed controls may be readjusted if necessary, though standard adjustments have been made on all controls in factory.

| Controls | PCB Marking | Location |
|-------------------------|--------------|-------------------------|
| Contrast | CONT | VR201 If equipped with. |
| Brightness | SUB-BRIGHT | VR651 |
| Horizontal video center | VIDEO CENTER | VR601 |
| Vertical hold | V-HOLD | VR501 |

Note: 1. All controls are located on main PCB.

2. SUB BRIGHT can be used as main brightness control if no connection is made to external brightness control.

3) External Brightness and Contrast Control Connection

If necessary, an external brightness control (B-100K OHM) and external contrast control (B-500 OHM) can be used under the following method with 10 pin cardedge board connector. -

Refer to INPUT SIGNAL INTERFACE.

Note: If the contrast control is used, check the items below.

1. Contrast control is not equipped with the unit, use EXTERNAL CONTRAST CONTROL as the Input Signal Interface.
2. Contrast control is equipped with the main PCB (VR201).
 - 1) Remove the VR 201 from main PCB.
 - 2) Remove Signal Cable (coaxial cable) from Point-S11 on main PCB.
 - 3) Then connect Signal Cable (coaxial cable) to Point-S11 (Slider of control VR) of main PCB
 - 4) Use EXTERNAL CONTRAST CONTROL as the Input Signal Interface

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OPERATION

4. Operation

4-1. Apply power and signals (Video, Vert-drive and Horiz-drive) as specified, and check the display synchronization.

4-2. Brightness Adjustment

Set external brightness (if connected) and contrast control (equipped with the unit or external) to its maximum, and adjust sub-brightness control for visual cutoff raster.

4-3. Contrast Adjustment

With brightness, set to visual raster cutoff, adjust the contrast control at the point where defocusing disappears when the control is turned down from its maximum.

Note:

Refer to ADJUSTMENT on page 14.

CAUTION FOR SERVICING

5. Caution

Before remove CRT, discharge the HIGH VOLTAGE throughly with the following procedures step 1 to 5 (Refer to Fig. 4)

WARNING: Great care must be taken because the High Voltage will be charged for approximately 30 hours or more after power is turned off. Discharge the High Voltage before assembling each of the units or servicing.

Procedures

Step 1. Remove the CRT Socket P.C.Board from CRT.

Step 2. Remove CRT Grounding Wire from CRT Socket P.C.Board.

Step 3. Discharge the High Voltage which has been charged in CRT. (See Fig. 4)

Step 4. Remove Anode Cap.

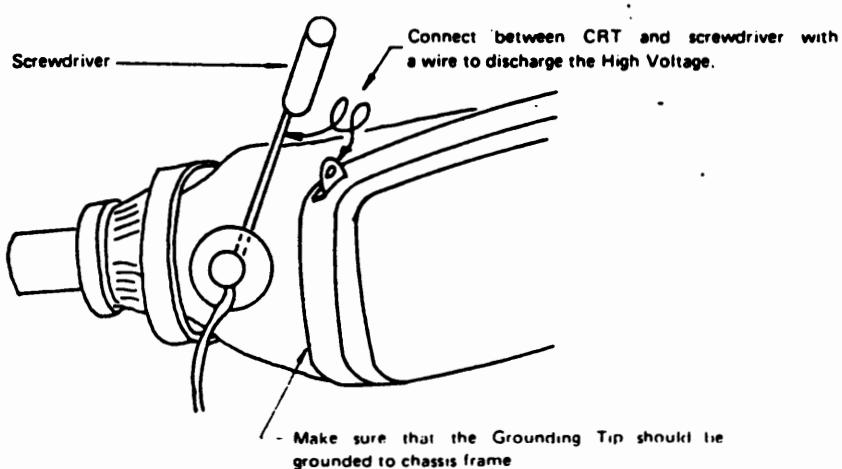


Fig. 4 Discharge of High Voltage

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ADJUSTMENT

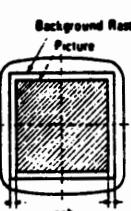
1. PREPARATION Make sure preparatory adjustment is made before proceeding the adjustment procedure.

1.1 DC INPUT VOLTAGE Set specified DC input voltage. (12 ± 0.1 V)

1.2 TEST SIGNAL Specified signal input voltage and timing. Character "H" should be displayed on the whole screen.

1.3 PICTURE SYNCHRONIZATION Synchronize the picture with V-Hold VR (VR501) for vertical.

2. ADJUSTMENT PROCEDURE (1. Refer to parts location diagram for points to be adjusted. 2. After servicing, make sure all the screws loosened for adjustment are re-tightened.)

| | Item | Setting Value | Point to be Adjusted | Adjustment |
|------|----------------------------|---------------|--|---|
| 2.1 | Horizontal Video Centering | | Background Raster Picture  | VIDEO CENTER (VR601) (1) Set External Brightness or sub-bright VR (VR651) to where background raster slightly appears. (2) Adjust Horizontal Video Center (VR601) to where the displayed picture is center of the background raster in horizontal. (Leave even space at left and right between each side of the background.) (3) After Horizontal Video Center Adjustment, set Brightness (or Sub-brightness) to where the background raster disappears. |
| 2.2 | Horizontal Linearity | | H. LIN Coil(L601) | Make width of character "H" at left, center and right even. Remarks: Horizontal width also change with this adjustment. |
| 2.3 | Horizontal Width | 92±5 mm | WIDTH Coil(L602) | Obtain the specified value. |
| 2.4 | Vertical Sync | | V-HOLD VR(VR501) | Center of hold range. |
| 2.5 | Vertical Linearity | | V-LIN VR(VR503) | (1) Adjust Vertical Height to obtain 2/3 to 3/4 of the specified value. |
| 2.6 | Height | 70±5 mm | HEIGHT VR(VR502) | (2) Adjust V-LIN to obtain equal height of character "H" at top and bottom. (3) Adjust HEIGHT VR to obtain specified value. |
| 2.7 | Contrast | | CONTRAST VR (VR201) | Optimum point, but do not saturate character "H". (If equipped with.) |
| 2.8 | Brightness | | SUB-BRIGHT VR (VR651) | (1) Set External Brightness VR (if equipped with) to maximum. (2) Set Sub-bright VR to where background raster disappears. |
| 2.9 | Focus | | FOCUS VR(VR652) | Adjust Focus VR to obtain overall focus. Remarks: Make sure Brightness has been adjusted. |
| 2.10 | Centering | | CENTERING Magnets | (1) Place display area in the middle of the CRT. (Leave even space at top and bottom, left and right between each side and edge of the CRT.) (2) Correct picture slant with DY by loosing the screw securing the DY. |

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FUNCTIONAL PRINCIPLE

6. Functional Principle

6-1. Video Amplifier

Video Amplifier consists of Q201, Q202, and its associated circuitry. A positive pulse is amplified and inverted by both transistors Q201 and Q202, and then injected to the cathode of CRT through R901. C201 compensates the high frequency of Video Amplifier, and VR651 controls the screen brightness of CRT. D654 and C653 are used as a spot killer when DC power source is cut off.

6-2. Vertical Circuit

The synchronous negative pulse inverted by Q501 through R501, C514 and R512 of differentiator circuit is injected to Pin 5 of IC501. The vertical free running frequency is determined by R504, R505, C503 and VR601. It is directly synchronized by the above pulse. As a result of the above operation, the rectangular pulse is generated at Pin 4 and is integrated to the sawtooth waveform by R506 and C505, and injected to Pin 7 through R607, VR502, and C504. Vertical linearity and height are respectively controlled by VR503 and VR502. The output at Pin 1 is loaded to L901 (Deflection Yoke) through C512. Q901 functions as ripple filter for the vertical circuit.

6-3. Horizontal Circuit

The base circuit of Q601 includes a clamp and a differentiator which makes Q601 output insensitive to drive pulse amplitude and width changes. The only requirement is that pulse amplitude be of 2.5 volts minimum and pulse width should be 10-40us. Q601 together with Q602 functions as a monostable multivibrator with Q603 being a slave that provides a positive feedback. Specifically, when Q601 is turned on by the drive pulse, it discharges C603 at a rate determined by the setting of VR601. When C603 is discharged to 2.75 volts, Q602 turns off. This change of state turns Q603 on and the base drive to Q602 from R606 is shunted thru Q603. Q602/Q603 remains in this state for nominally 25us until C603 recharges through A103 to 4 volts. At this time, Q602 is biased on again by the current through VR601. The multivibrator is now in a state that Q602 is on and Q601/Q603 is off. It will remain in this state until the next drive pulse occurs or power is turned off. C603 is the only timing capacitor in the circuit and has two time constants associated with it. Primarily, the charge path between pin 1 and pin 3 of VR601 determines the on time of Q603 while the discharge path through the video centering control and Q601 determines the delay between application of the drive pulse and start of retrace (turn on of Q603).

6-4. High Level Stages

The output of Q603 is driven to the base of Q604 through T601. The horizontal output circuit consists of Q604, D604, L901, T602 and its associated circuitry. Q604 operates as a switch when affected by the driving pulse and supplies the sawtooth current to L901. D604 is a damper diode. C617, C605 and C606 are called resonance capacitors. The output pulse of T602 is rectified by D653, D652 and D651 for CRT G2, video amplifier, and brightness circuits respectively. L602 and L601 control the width and horizontal linearity.

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7. TROUBLESHOOTING

Plug in an edge input connector.

— No Raster appears.

— Line voltage drops. —> Check B+ lines of the horizontal output.

— Normal line voltage. —> Check horizontal, CRT, and video circuits.

— Only one horizontal raster line —> Check for defects in Q701, vertical circuit, and deflection yoke for breaks or short in the wire.

— Only one vertical raster line —> Check for defects in horizontal output circuit and deflection yoke for breaks or short in the wire.

Raster appears.

— Insufficient horizontal width —> Check horizontal circuits.

— Unusual vertical size —> Readjust VR502 and VR503, or check Q701 and vertical circuit.

— Dark screen —> Readjust VR651 or check CRT's associated circuitry.

— Vertical hold is not synchronized. —> Check vertical circuit.

— No picture —> Check video circuit.

Picture appears.

— Dot brightness is different horizontally and vertically. —> Check video circuit.

— Out of focus —> Check CRT and VR652.

— Picture appears intermittently. —> Check for insufficient soldering in video and horizontal circuits.

— Incorrect horizontal centering. —> Readjust VR601.

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8. HOW TO REPAIR

8-1. No Raster (1)

No Raster appears.

Does the raster appear at maximum brightness? — YES —> Readjust brightness.

NO

Are there any troubles on B+ line and horizontal circuit?

NO

Is B+ applied to pin 7 of 10 pin-card connector? — NO —> Check the card connector.

YES

Is rectangular waveform applied to the collector of Q603?

YES

Is power output of horizontal drive circuit applied to the Base of Q604?

NO

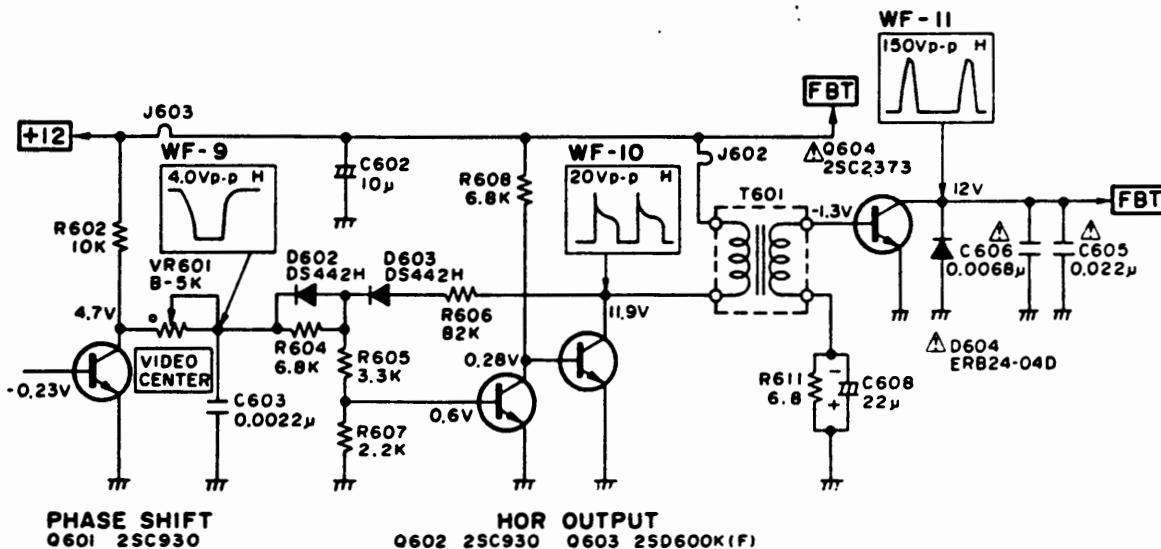
Check horizontal phase shift circuit Q601.
WF-9

YES

Check horizontal output circuit Q604.
WF-11

NO

Check horizontal drive circuit Q603.
WF-10



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8-2. No Raster (2)

No Raster appears. (In the case of faulty high voltage and CRT circuits)

Is high voltage applied to the anode of CRT ?

YES

Is normal heating voltage applied to CRT's Pin-3 and Pin-4 ?

YES

Is normal grid voltage (Eg2) applied to CRT's Pin-6 ?

YES

Is normal cathode voltage applied to CRT's Pin-2 ?

YES

Check CRT.

NO

Check video circuit.

NO

Are pulses applied to the collector of horizontal output Q604 ? : WF-11

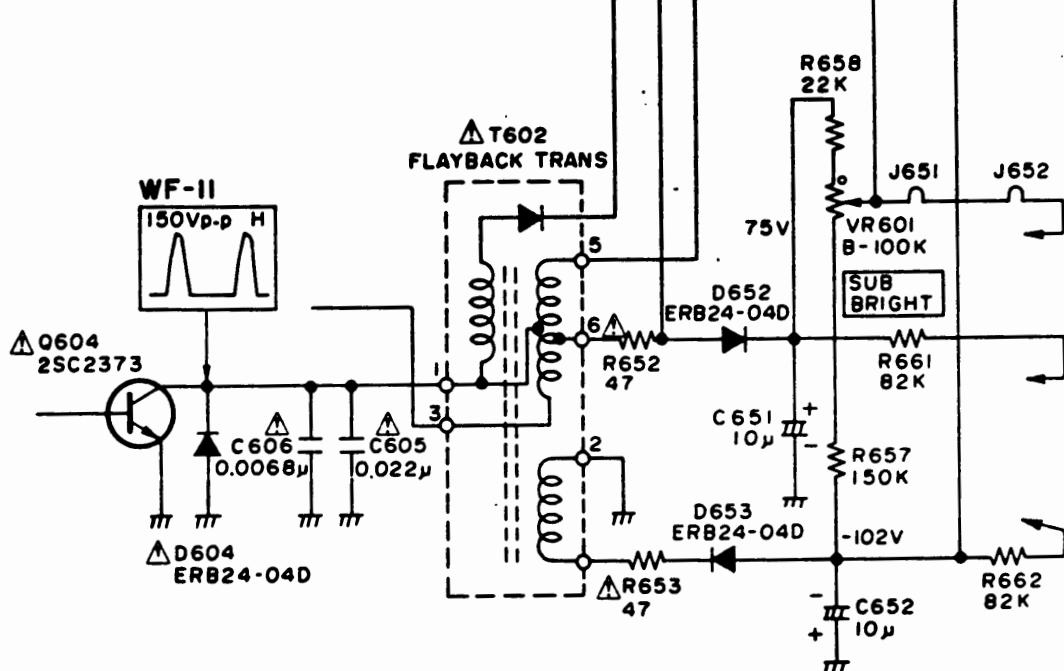
YES

Check flyback transformer.

NO

Check horizontal output circuit.

Note: Check high voltage by approaching the oscilloscope probe, or measure it with a high voltage meter, as high voltage is not able to be measured by a tester.



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8-3. Only One Horizontal Raster Line

Only one horizontal raster line appears.

Troubles in vertical deflection circuit

Is output voltage applied to DY's terminals (WD4) ? : WF-7

NO

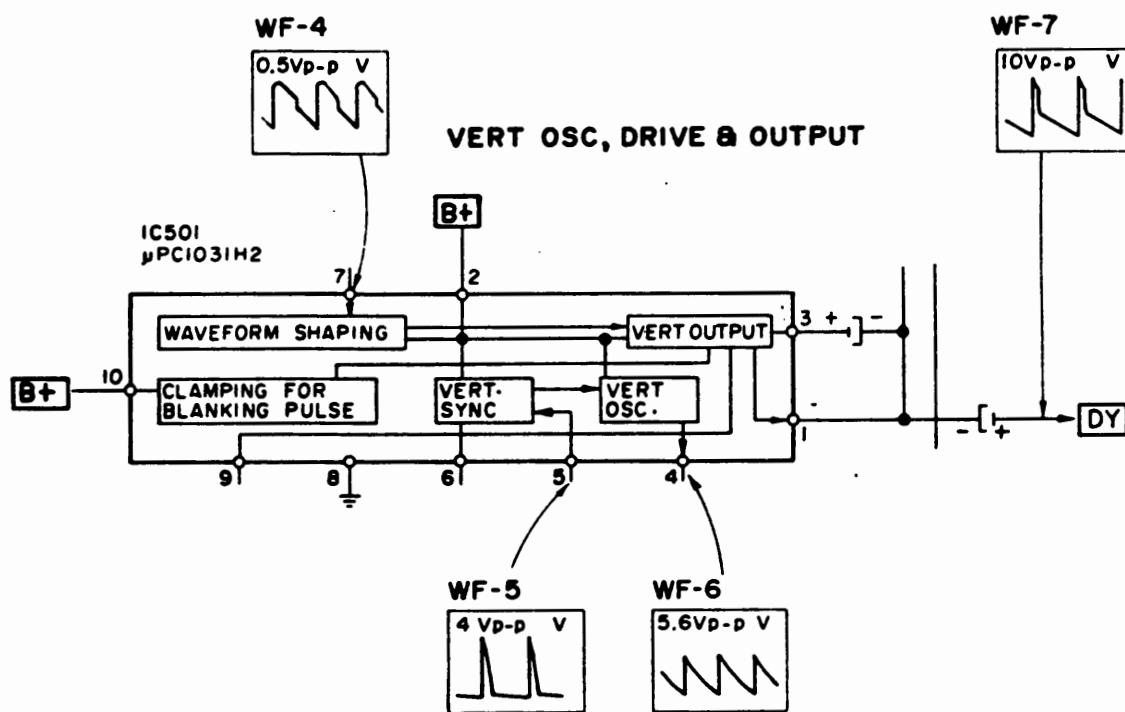
Is output applied to Pin-1 of IC ? ————— YES —————> Check DY leads and defective connectors.

NO

Is B+ applied to Pin-2 and Pin-10 of IC ? ————— NO —————> Check B+ line.

YES

Check IC and its associated circuits : WF-4,5 and 6



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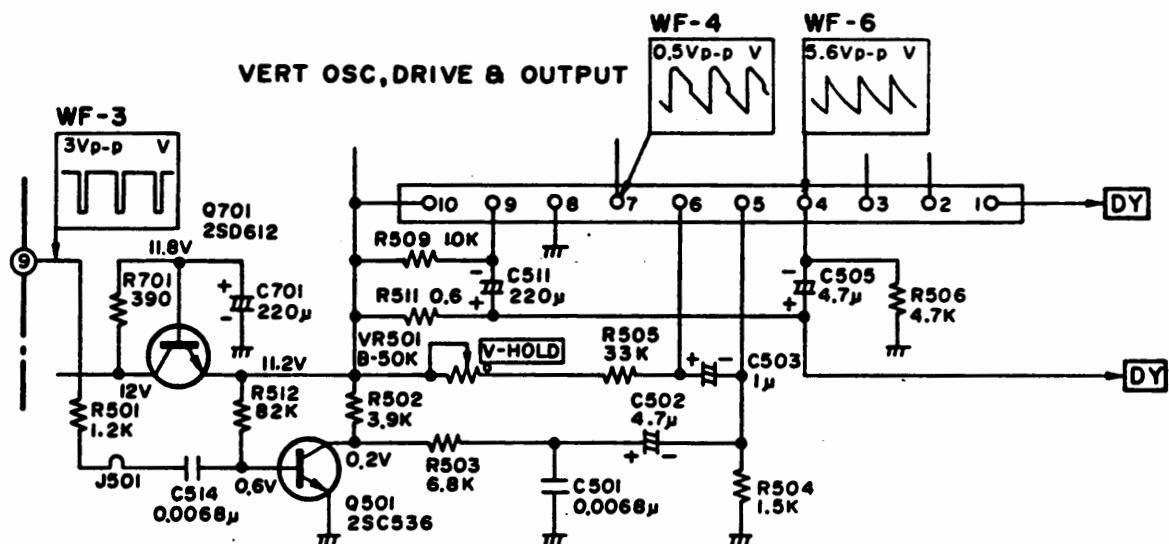
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8-4. Vertical Synchronizing Trouble

Vertical hold is not synchronized.

Are the positive vertical synchronous pulses applied to WF-3? — NO — Check defective connectors of deflection yoke.
YES

Check VR501.



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8-5. Improper Vertical Size

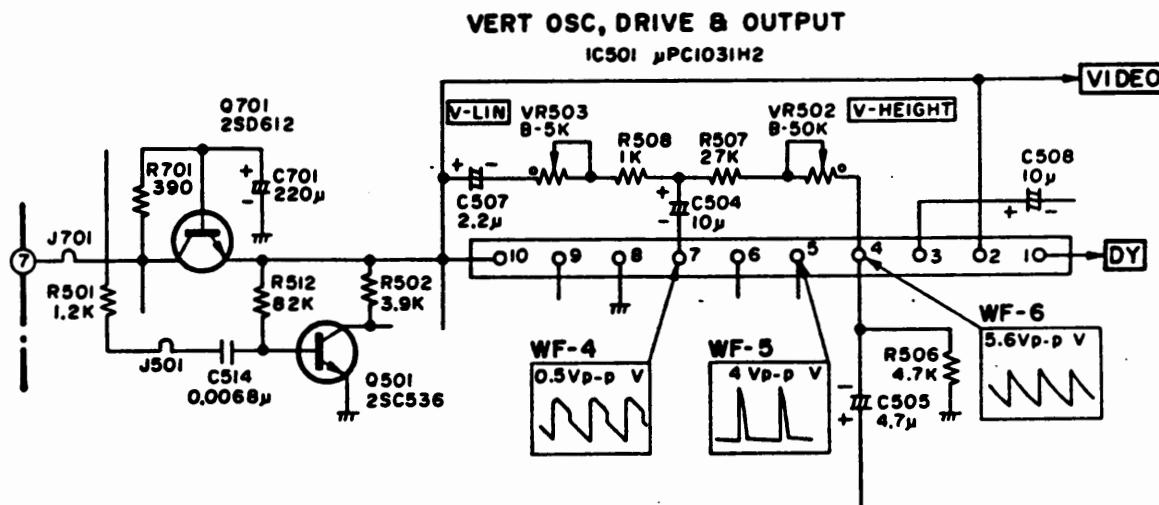
Improper vertical size

Is normal DC voltage applied to the emitter of Q701 ? — NO — Check Q701.

YES

Check VR502 and VR503

Check IC and its associated circuits : WF-4, 5 and 6



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| | | HOW TO REPAIR | |
| | | DDC5NDG | PAGE 11 PAGES 21/32 |

8-6. No Picture

No picture appears.

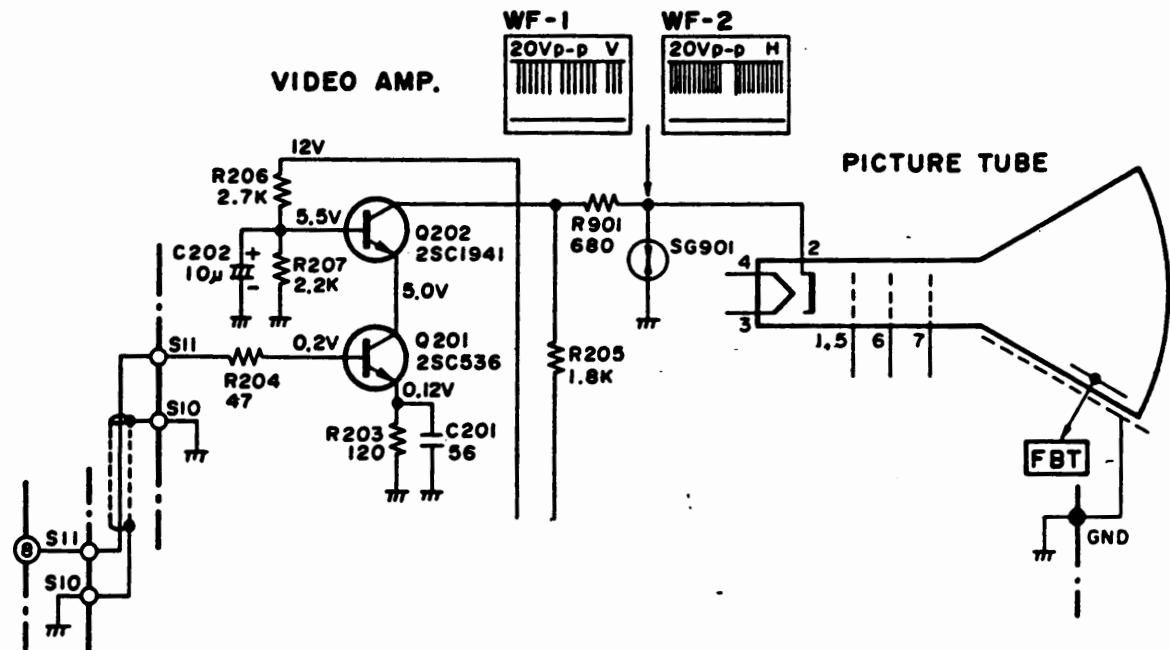
Does raster appear when brightness control is at maximum position ? — NO — Refer to the troubleshooting "No Raster appears".

YES

Are input signals completely supplied ? — NO — Check the signal source.

YES

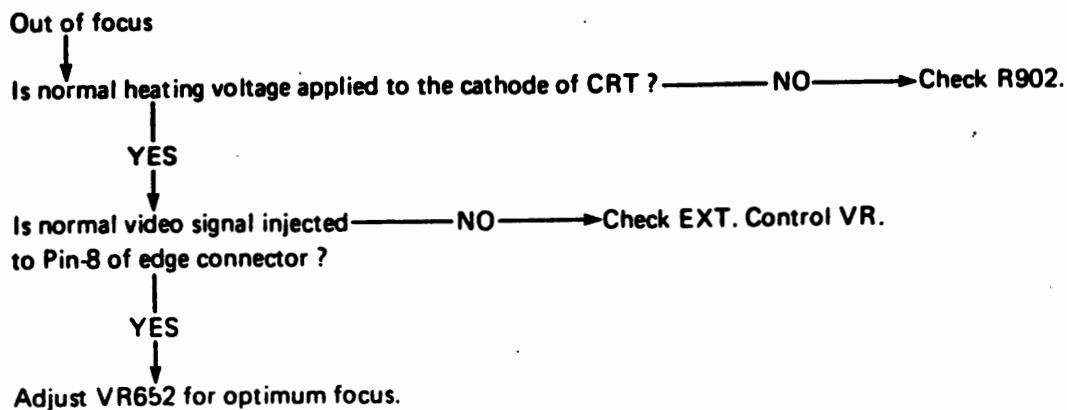
Check video circuit : WF-1.



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| REVISION | DRAWN | MINTEL DDC5NDG | PAGE 1 PAGES 22/32 |
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8-7. Out of Focus

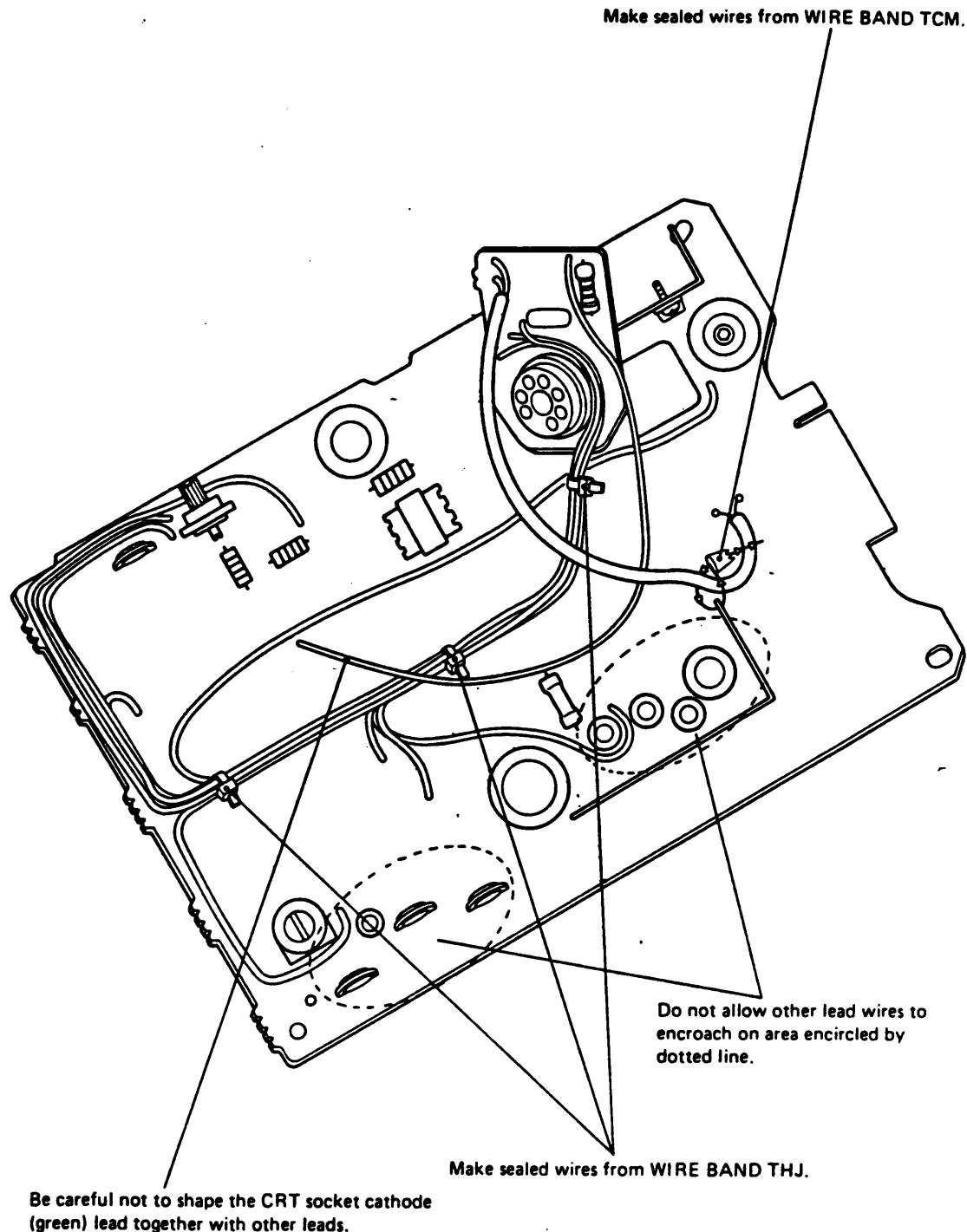


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| | DRAWN | MODEL / DDC5NDG | PAGE / PAGES 23/32 |
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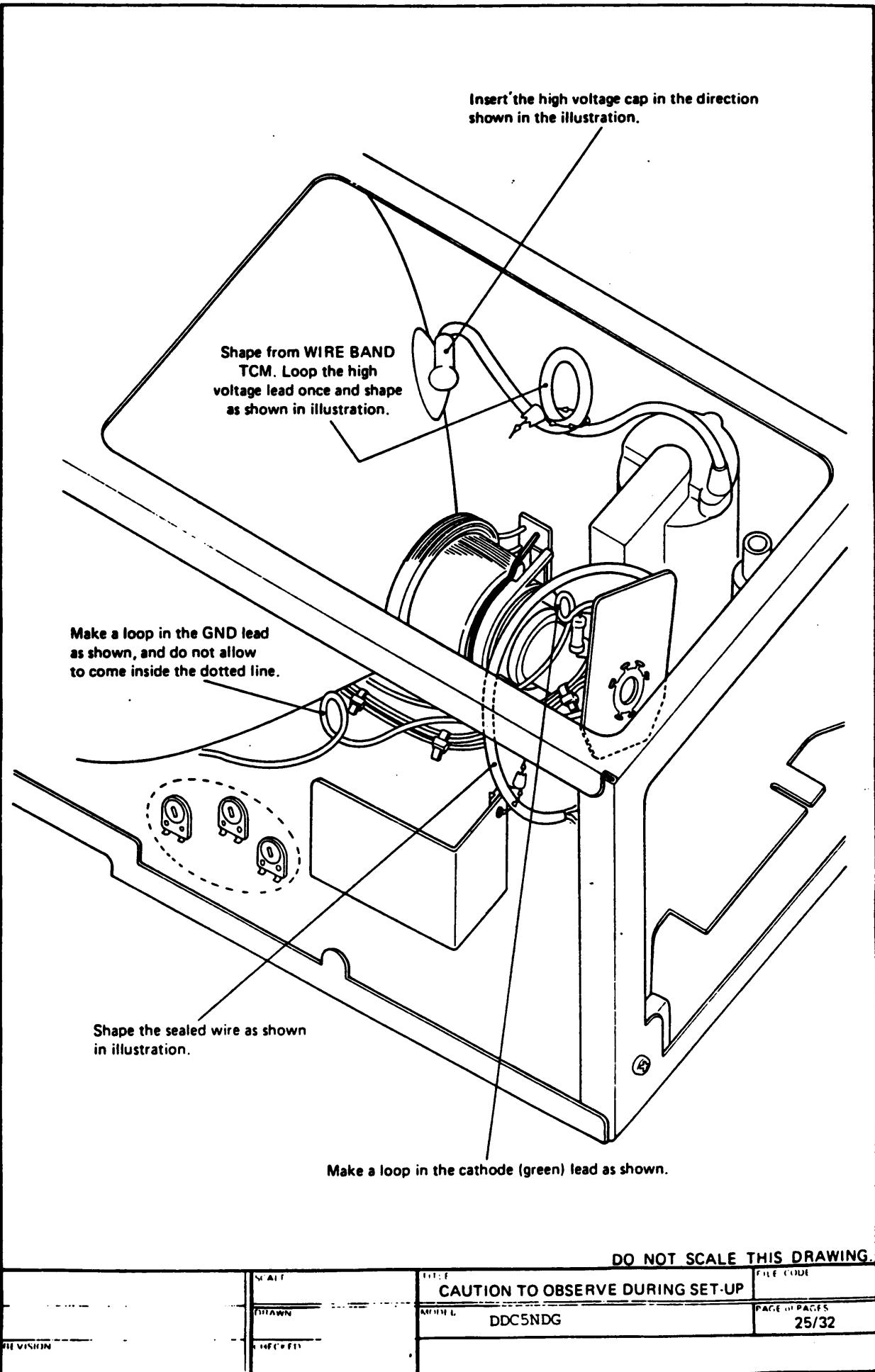
CAUTIONS TO OBSERVE DURING SET-UP

9-1 Configuration Of Lead Wires



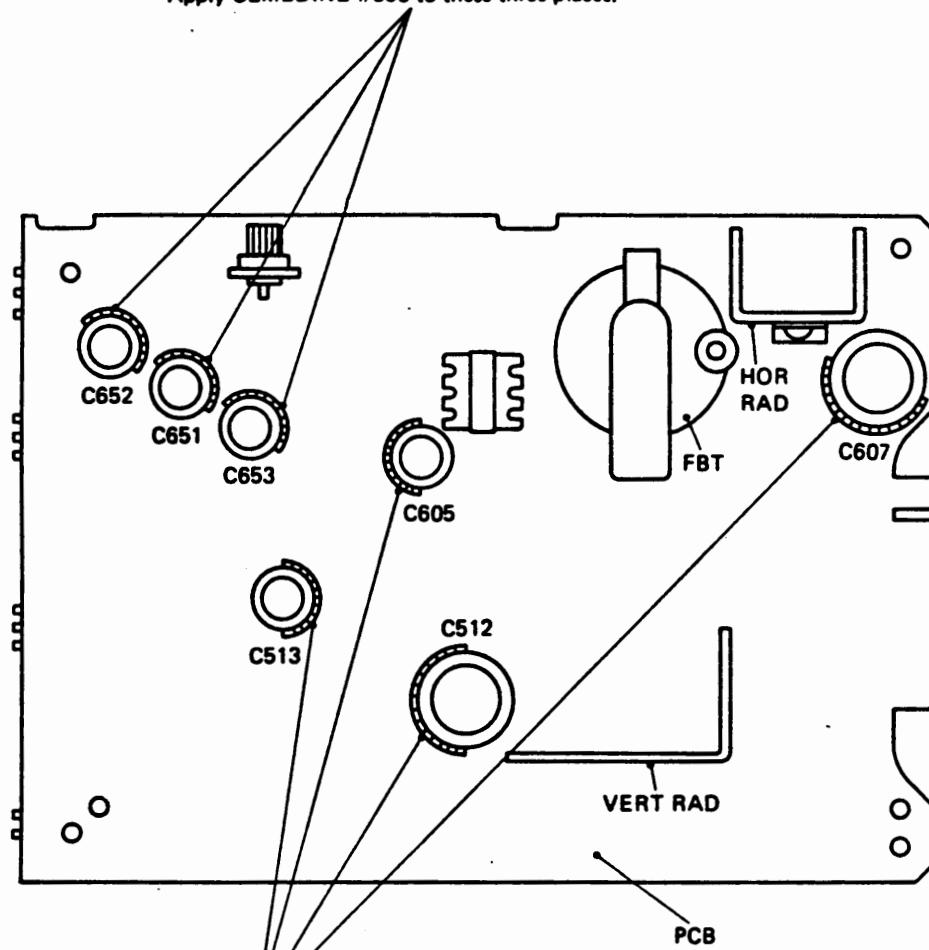
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| REVISION | SCALE | TITLE CAUTION TO OBSERVE DURING SET-UP | FILE CODE |
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| | DRAWN | MODEL DDC5NDG | PAGE OF PAGES 24/32 |
| | CHECKED | | |

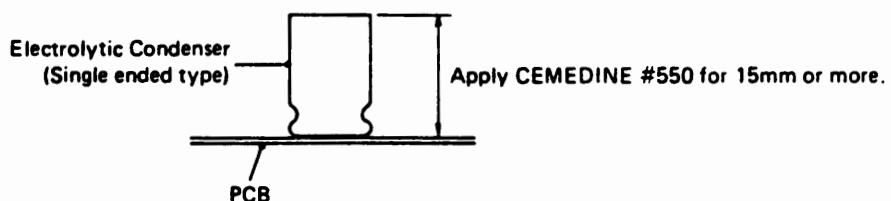


9.2 Where to apply cemedine.

Apply CEMEDINE #550 to these three places.



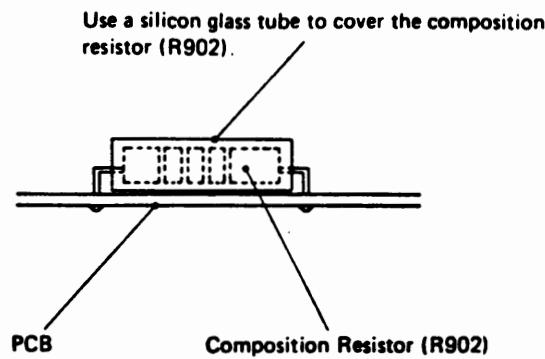
NOTE: When replacing electrolytic condenser (Single ended type), apply CEMEDINE #550 for 15mm or more to the condenser height above the base plate.



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| SCALE | TITLE | FILE CODE |
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| DRAWN | CAUTION TO OBSERVE DURING SET-UP | PAGE 1 PAGES |
| REVISION | MODEL | 26/32 |
| SHELFED | | |

9-3 Where to use a silicon glass tube.



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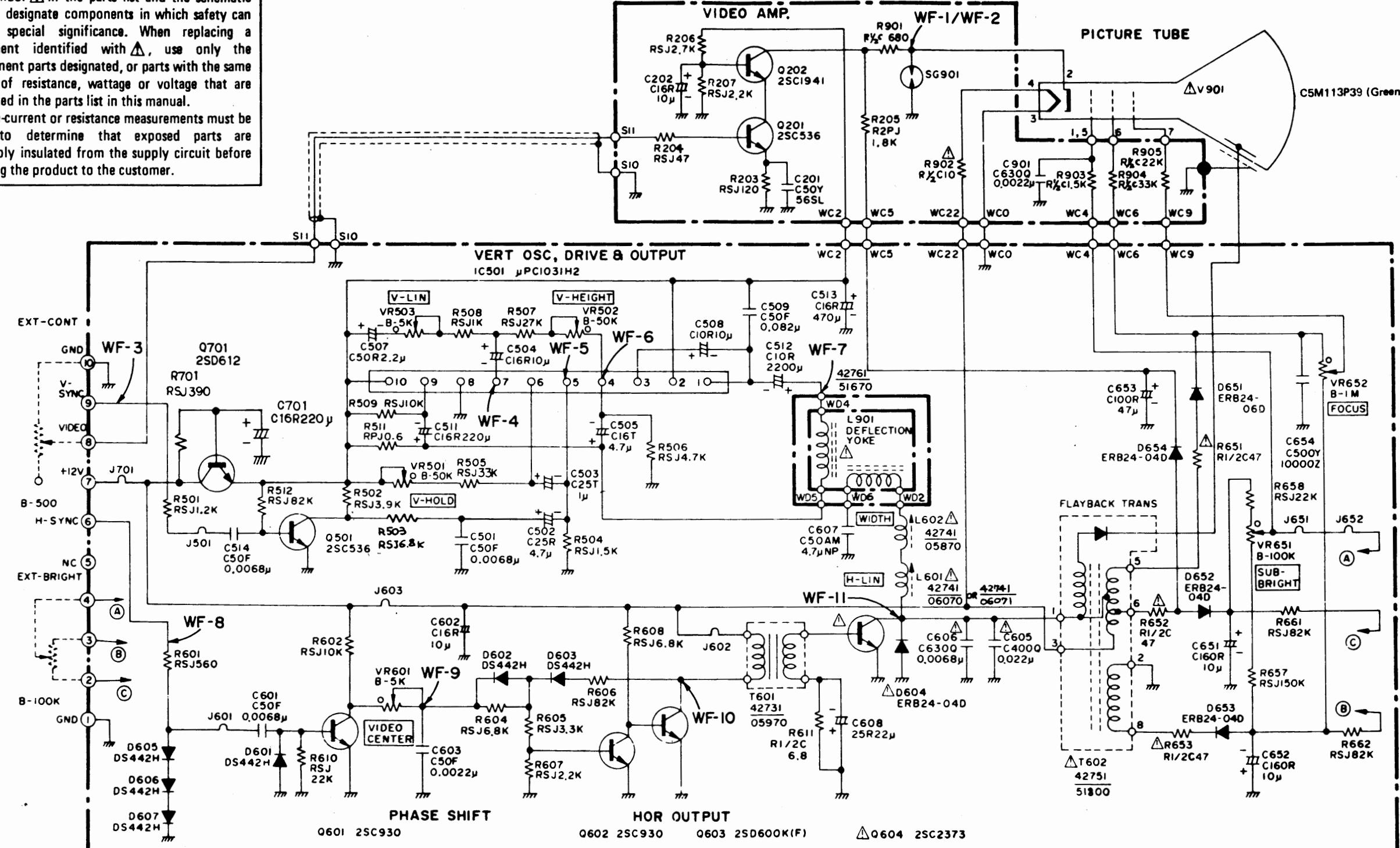
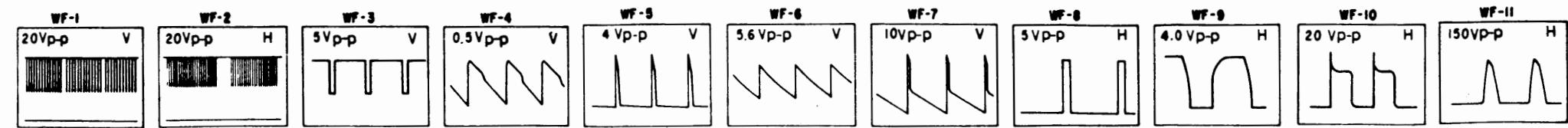
| SCALE | TITLE | FILE CODE |
|----------|----------------------------------|------------------------|
| DRAWN | CAUTION TO OBSERVE DURING SET-UP | |
| | MODEL DDC5NDG | PAGE OF PAGES 27/32 |
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SCHEMATIC DIAGRAM

PRODUCT SAFETY NOTICE

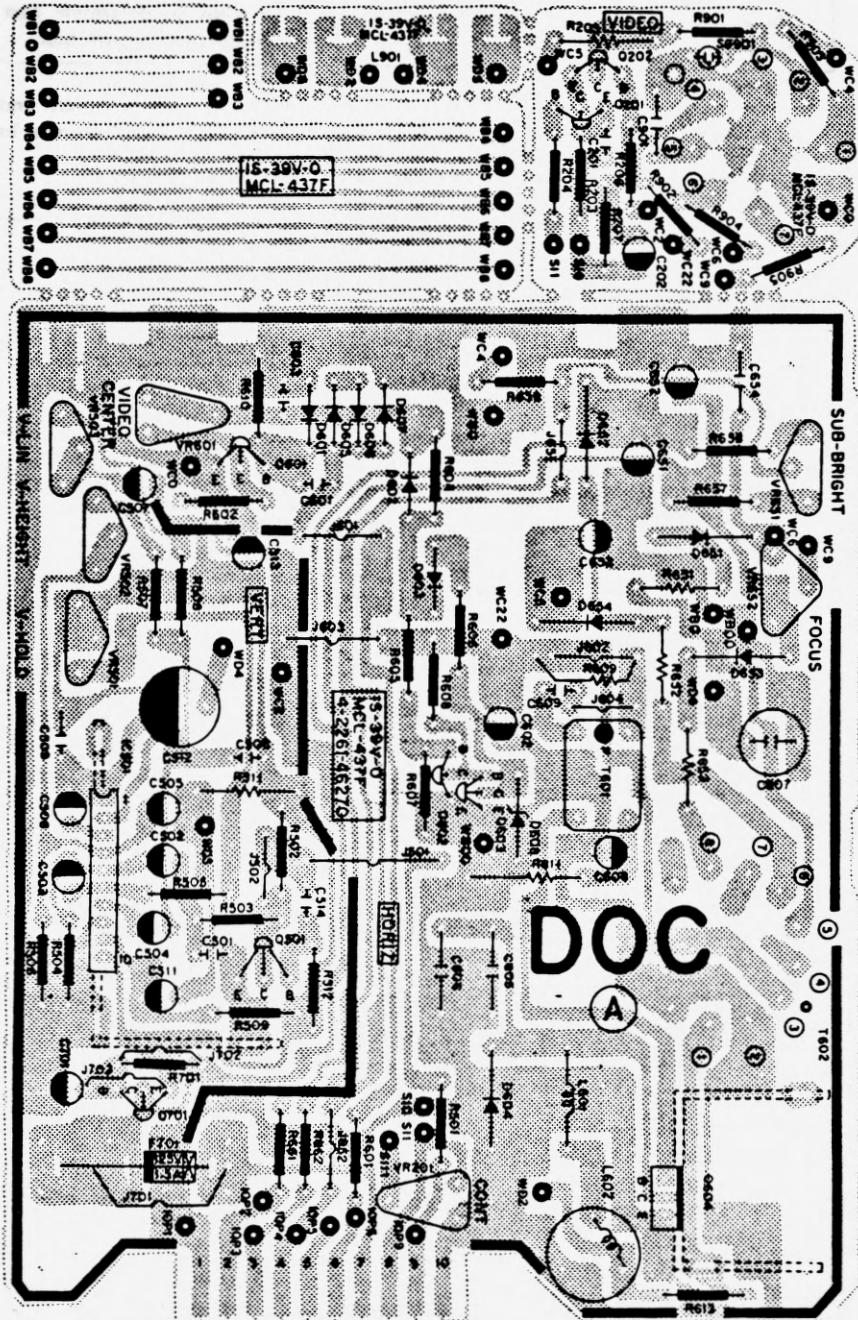
Each precaution in this manual should be followed during servicing. Components identified with the IEC symbol Δ in the parts list and the schematic diagram designate components in which safety can be of special significance. When replacing a component identified with Δ , use only the replacement parts designated, or parts with the same ratings of resistance, wattage or voltage that are designated in the parts list in this manual.

Leakage-current or resistance measurements must be made to determine that exposed parts are acceptably insulated from the supply circuit before returning the product to the customer.



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| REVISION | NOTES: | SCALE | TITLE | FILE CODE |
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| | 1. All resistance values in ohm. K=1,000 M=1,000,000 2. Unless otherwise noted in schematic diagram, all capacitors less than 1 are expressed in mfd (μ F) and the values larger than 1 are in pF. 3. Voltage reading taken with High Impedance Voltmeter from point indicated chassis ground, contrast at max., other controls at normal, local linevoltage (or specified DC 12V). Voltage reading may vary $\pm 20\%$. 4. This is a fundamental circuit diagram. Some production changes may be made without revision of the diagram. 5. Δ : SAFETY use only equivalent replacement parts. | DRAWN | SCHEMATIC DIAGRAM | DDC5NDG |
| | | CHECKED | | PAGE of PAGES 28/32 |



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| | SCALE | TITLE | FILE CODE |
| | DRAWN | MATERIAL | CIRCUIT BOARD DIAGRAM |
| REVISION | CHECKED | DDC5NDG | PAGE OF PAGES 29/32 |

PARTS LIST

PRODUCT SAFETY NOTICE

Each precaution in this manual should be followed during servicing. Components identified with the IEC symbol **Δ** in the parts list and the schematic diagram designate components in which safety can be of special significance. When replacing a component identified with **Δ**, use only the replacement parts designated, or parts with the same ratings of resistance, wattage or voltage that are designated in the parts list in this manual.

Leakage-current or resistance measurements must be made to determine that exposed parts are acceptably insulated from the supply circuit before returning the product to the customer.

NOTES:

1. Parts orders must contain Model Number, Parts Number and Description.
2. Ordering quantity of resistors, capacitors and screws must be multiple of 10 pcs.

| Schematic Location | Parts No. | Description | Q'ty |
|---------------------------------|------------------|---------------------|------|
| CHASSIS PARTS | | | |
| | 111 2 3121 19870 | CHASSIS FRAME-MDK | 1 |
| | 111 2 3441 17070 | CRT MTG BRKT-MDK | 1 |
| | 111 2 6211 22770 | VERT RAD PLATE-TJJ | 1 |
| | 111 2 6211 23370 | AUDIO RAD PLATE-TMB | 1 |
| | 111 2 6231 16570 | GROUNDING TIP-MDK | 1 |
| | 111 2 7211 13270 | WIRE BAND-TCM | 2 |
| | 111 2 7211 14870 | WIRE BAND-THJ-B | 3 |
| ACCESSORIES & LABELS | | | |
| | 111 6 4551 16970 | SERIAL NO LABEL | 1 |
| | 111 6 4761 36170 | SPEC LABEL-MDK | 1 |
| | 111 6 4761 35971 | HOR RATE LABEL-MBN | 1 |
| | 111 6 4761 35971 | HOR RATE LABEL-MBN | 1 |
| | 111 6 4761 35971 | HOR RATE LABEL-MBN | 2 |
| | 111 6 4791 12154 | MDL NO. LABEL-MDK | 1 |
| | 111 6 4791 12154 | MDL NO. LABEL-MDK | 4 |
| | 111 6 4791 13376 | CRT IND LABEL-G | 4 |
| | 111 6 4791 13376 | CRT IND LABEL-G | 4 |
| SCREW-CHASSIS | | | |
| | 102 3 2203 00601 | SBRT2, 3.0x6, Z1 | 2 |
| | 102 3 2203 00802 | SBRT2, 3.0x8, Z1 | 6 |
| | 111 2 4211 15770 | COMB TAP SCREW-MBN | 4 |
| ELECTRICAL PARTS | | | |
| △ L601 | 4 2741 06070 | LINEARITY COIL | 1 |
| △ or | 4 2741 06071 | LINEARITY COIL | 1 |
| △ L602 | 4 2741 05870 | WIDTH COIL | 1 |
| △ L901 | 4 2761 51670 | DEFLECTION YOKE | 1 |
| T601 | 4 2731 05970 | HOR DRIVE TRANS | 1 |
| △ T602 | 4 2751 51800 | FLYBACK TRANS | 1 |
| SMALL PARTS | | | |
| | 4 2261 46270 | PC BOARD DOC | 1 |
| | 4 2350 61600 | TERMINAL SOCKET | 1 |
| | 4 2351 05470 | CRT SOCKET | 1 |
| | 4 2361 05570 | GT PIN | 1 |
| SG901 | 4 2341 06270 | SPARK GAP | 1 |
| or | 4 2341 07770 | SPARK GAP | 1 |

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| MADE | PARTS LIST | FILE CODE |
| DRAWN | DDC5NDG | PAGE OF PAGES 30/32 |
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PARTS LIST

| Schematic Location | Parts No. | Description | Q'ty | | |
|---------------------------|--------------|-------------|---------|------|------|
| VARIABLE RESISTORS | | | | | |
| VR501 | 4 2221 24270 | 10FFRB-50K | 1 | | |
| VR502 | 4 2221 24270 | 10FFRB-50K | 1 | | |
| VR503 | 4 2221 23970 | 10FFRB-5K | 1 | | |
| VR601 | 4 2221 33870 | 9CVFR9B-5K | 1 | | |
| VR651 | 4 2221 24370 | 10FFRB-100K | 1 | | |
| VR652 | 4 2221 35070 | 15CHFR7B-1M | 1 | | |
| CAPACITORS | | | | | |
| C201 | C1HCDK560SL- | CERAMIC | 56P | SL | 50V |
| C202 | C1CRE-106A.. | ELECT | 10M | | 16V |
| C501 | C1HFRK682A.. | MYLAR | 0.0068M | | 50V |
| C502 | C1ERE-475A.. | ELECT | 4.7M | | 25V |
| C503 | C1ETDM105A.. | TANTAL | 1M | | 25V |
| or | C1EUEM105A.. | ELECT | 1M | | 25V |
| C504 | C1CRE-106A.. | ELECT | 10M | | 16V |
| C505 | C1CTDM475A.. | TANTAL | 4.7M | | 16V |
| or | C1CUEM475A.. | ELECT | 4.7M | | 16V |
| C507 | C1HRE-225A.. | ELECT | 2.2M | | 50V |
| C508 | C1CRE-106A.. | ELECT | 10M | | 16V |
| C509 | C1HFRK823A.. | MYLAR | 0.082M | | 50V |
| C511 | C1CRE-227A.. | ELECT | 220M | | 16V |
| C512 | C1ARE-228A.. | ELECT | 2200M | | 10V |
| C513 | C1CRE-477A.. | ELECT | 470M | | 16V |
| C514 | C1HFRK682A.. | MYLAR | 0.0068M | | 50V |
| C601 | C1HFRK682A.. | MYLAR | 0.0068M | | 50V |
| C602 | C1CRE-477A.. | ELECT | 470M | | 16V |
| C603 | C1HFRK222A.. | MYLAR | 0.0022M | | 50V |
| △ C605 | C2GQRK223A.. | POLYPR | 0.022M | | 400V |
| △ C606 | C2JQRK682A.. | POLYPR | 0.0068M | | 630V |
| C607 | C1HAEM009T.. | ELECT | 4.7M | | 50V |
| C608 | C1ERE-226A.. | ELECT | 22M | | 25V |
| C651 | C2CRE-106A.. | ELECT | 10M | | 160V |
| C652 | C2CRE-106A.. | ELECT | 10M | | 160V |
| C653 | C2ARE-476A.. | ELECT | 47M | | 100V |
| C654 | C2HYDP103Z.. | CERAMIC | 0.01M Z | | 500V |
| C701 | C1CRE-227A.. | ELECT | 220M | | 16V |
| C901 | C2JQRK222A.. | POLYPR | 0.0022M | | 630V |
| FIXED RESISTORS | | | | | |
| R203 | R2ESPJ121A | CARBON | 120 | 1/4W | J 1 |
| R204 | R2ESPJ470A | CARBON | 47 | 1/4W | J 1 |
| R205 | R3DXPJ182A | OXIDE-M | 1.8K | 2W | J 1 |
| R206 | R2ESPJ272A | CARBON | 2.7K | 1/4W | J 1 |
| R207 | R2ESPJ222A | CARBON | 2.2K | 1/4W | J 1 |
| R501 | R2ESPJ122A | CARBON | 1.2K | 1/4W | J 1 |
| R502 | R2ESPJ392A | CARBON | 3.9K | 1/4W | J 1 |
| R503 | R2ESPJ682A | CARBON | 6.8K | 1/4W | J 1 |
| R504 | R2ESPJ152A | CARBON | 1.5K | 1/4W | J 1 |
| R505 | R2ESPJ333A | CARBON | 33K | 1/4W | J 1 |
| R506 | R2ESPJ472A | CARBON | 4.7k | 1/4W | J 1 |
| R507 | R2ESPJ273A | CARBON | 27K | 1/4W | J 1 |
| R508 | R2ESPJ102A | CARBON | 1K | 1/4W | J 1 |

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| | DRAWN | MODEL | DDC5NDG | PAGE OF PAGES 31/32 |
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PARTS LIST

| Schematic Location | Parts No. | Description | Q'ty | | | |
|--------------------|------------|-------------|------|------|---|---|
| R509 | R2ESPJ103A | CARBON | 10K | 1/4W | J | 1 |
| R511 | R3APPJ0R6A | OXIDE-M | 0.6 | 1W | J | 1 |
| R512 | R2ESPJ823A | CARBON | 82K | 1/4W | J | 1 |
| R601 | R2ESPJ561A | CARBON | 560 | 1/4W | J | 1 |
| R602 | R2ESPJ103A | CARBON | 10K | 1/4W | J | 1 |
| R604 | R2ESPJ682A | CARBON | 6.8K | 1/4W | J | 1 |
| R605 | R2ESPJ332A | CARBON | 3.3K | 1/4W | J | 1 |
| R606 | R2ESPJ823A | CARBON | 82K | 1/4W | J | 1 |
| R607 | R2ESPJ222A | CARBON | 2.2K | 1/4W | J | 1 |
| R608 | R2ESPJ682A | CARBON | 6.8K | 1/4W | J | 1 |
| R610 | R2ESPJ223A | CARBON | 22K | 1/4W | J | 1 |
| R611 | R2HCPJ6R8A | SOLID | 6.8 | 1/2W | J | 1 |
| ▲ R651 | R2HCPK470A | SOLID | 47 | 1/2W | K | 1 |
| ▲ R652 | R2HCPK470A | SOLID | 47 | 1/2W | K | 1 |
| ▲ R653 | R2HCPK470A | SOLID | 47 | 1/2W | K | 1 |
| R657 | R2ESPJ154A | CARBON | 150K | 1/4W | J | 1 |
| R658 | R2ESPJ223A | CARBON | 22K | 1/4W | J | 1 |
| R659 | R2ESPJ153A | CARBON | 15K | 1/4W | J | 1 |
| R661 | R2ESPJ823A | CARBON | 82K | 1/4W | J | 1 |
| R662 | R2ESPJ823A | CARBON | 82K | 1/4W | J | 1 |
| R701 | R2ESPJ391A | CARBON | 390 | 1/4W | J | 1 |
| R901 | R2HCPK681A | SOLID | 680 | 1/2W | K | 1 |
| ▲ R902 | R2HCPK100A | SOLID | 10 | 1/2W | K | 1 |
| R903 | R2HCPK152A | SOLID | 1.5K | 1/2W | K | 1 |
| R904 | R2HCPK333A | SOLID | 33K | 1/2W | K | 1 |
| R905 | R2HCPK223A | SOLID | 22K | 1/2W | K | 1 |

TUBES & SEMICONDUCTORS

| | | | |
|--------|----------------|---|---|
| D601 | 4 2021 21070 | SI DIODE DS442H | 1 |
| D602 | 4 2021 21070 | SI DIODE DS442H | 1 |
| D603 | 4 2021 21070 | SI DIODE DS442H | 1 |
| ▲ D604 | 4 2021 10270 | SI DIODE ERB24-04D | 1 |
| D605 | 4 2021 21070 | SI DIODE DS442H | 1 |
| D606 | 4 2021 21070 | SI DIODE DS442H | 1 |
| D607 | 4 2021 21070 | SI DIODE DS442H | 1 |
| D651 | 4 2021 10470 | SI DIODE ERB24-06D | 1 |
| D652 | 4 2021 10270 | SI DIODE ERB24-04D | 1 |
| D653 | 4 2021 10270 | SI DIODE ERB24-04D | 1 |
| D654 | 4 2021 10270 | SI DIODE ERB24-04D | 1 |
| IC501 | 4 2061 08670 | IC-UPC1031H2 | 1 |
| Q201 | TG2SC536..... | SI TR 2SC536 | 1 |
| Q202 | TN2SC1941..... | SI TR 2SC1941 | 1 |
| Q501 | TG2SC536..... | SI TR 2SC536 | 1 |
| Q601 | TG2SC930..... | SI TR 2SC930NP | 1 |
| Q602 | TG2SC930..... | SI TR 2SC930NP | 1 |
| Q603 | TG2SD600K-F.. | SI TR 2SD600K | 1 |
| ▲ Q604 | TN2SC2373-5 | SI TR 2SC2373-5 | 1 |
| Q701 | TG2SD612..... | SI TR 2SD612 | 1 |
| ▲ V901 | QTME2765B4LNS | CRT E2765B4(LG)-HT White (DC6005NL) | 1 |
| ▲ V901 | QTME2765B31LN | CRT E2765B31(LG)-HT Green (DC6105NL) | 1 |
| ▲ V901 | QTME2765B31LS | CRT E2765B31(LG) Green (DC6105NL) | 1 |
| ▲ or | QNMC5M113P39S | CRT C5M113P39 Green (DDC5NDG) | 1 |

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| | REV A | PARTS LIST | FILE CODE |
| | DRAWN BY | DDC5NDG | PAGE OF PAGES 32/32 |
| REVISION | APR 1970 | | |